User's Manual

Model SC100
Panel Mount Conductivity Converter

IM 12D11A01-01E

YOKOGAWA
Yokogawa Electric Corporation

IM 12D11A01-01E
1st Edition

◆ Introduction

This manual covers the specifications, installation, operation and maintenance of the panel-mount version of the SC100 Conductivity converter. Please read this before using the SC100.
There are manuals for the related EXA100 series as follows:
Refer to them as required.

Model code	Manual Name	IM No.
PH100	Panel Mount pH Converter	IM 12 B11A01-01E
OR100	Panel Mount ORP Converter	IM 12 C11A01-01E
SC100	Panel Mount Conductivity Converter	IM 12 D11A01-01E
PH10FP	KCl Refillable pH Sensor	IM 12 B11C01-01E
PH10RP	KCl Replenish-free pH Sensor	IM 12 B11C02-01E
OR10FP	KCl Refillable ORP Sensor	IM 12 C11C01-01E
OR10RP	KCl Replenish-free ORP Sensor	IM 12 C11C02-01E
SC10XB	Conductivity Sensor for SC100	IM 12 D11C01-01E
WTB100	Terminal Box for EXA100	IM 12 B11E01-01E
WF100	Extension Cable for EXA100	IM 12 B11F01-01E
PH10HLD	Immersion Holder for EXA100	IM 12 B11D01-01E
PH10HG	Guide-pipe Holder for EXA100	IM 12 B11D02-01E

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IM 12D11A01-01E
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◆ For the safe use of this equipment

(1) About This Manual

- This manual should be passed on to the end user.
- The contents of this manual are subject to change without prior notice.
- The contents of this manual shall not be reproduced or copied, in part or in whole, without permission.
- This manual explains the functions contained in this product, but does not warrant that they will suit the particular purpose of the user.
- Every effort has been made to ensure accuracy in the preparation of this manual. However, should any errors or omissions come to the attention of the user, please contact the nearest Yokogawa Electric representative or sales office.
- This manual does not cover the special specifications. This manual may be left unchanged on any change of specification, construction or parts when the change does not affect the functions or performance of the product.
- If the product is used in a manner not specified in this manual, the safety of this product may be impaired.

(2) Safety and Modification Precautions

- Follow the safety precautions in this manual when using the product to ensure protection and safety of personnel, product and system containing the product.

(3) The following safety symbols are used on the product as well as in this manual.

DANGER

This symbol indicates that the operator must follow the instructions laid out in this manual in order to avoid the risk of personnel injury, electric shock, or fatalities. The manual describes what special care the operator must exercise to avoid such risk.

WARNING

This symbol indicates that the operator must refer to the instructions in this manual in order to prevent the instrument (hardware) or software from being damaged, or a system failure from occurring.

CAUTION

This symbol draws attention to information essential for understanding the operation and functions.

Tip

This symbol gives information that complements the current topic.

SEE ALSO

This symbol identifies a source to which to refer.

Protective Ground Terminal

Function Ground Terminal (Do not use this terminal as the protective ground terminal.)

 Alternating current

◆ NOTICE and Cautions

• Check specifications

When the instrument arrives, unpack the package with care and check that the instrument has not been damaged during transportation. In addition, please check that the specification matches the order, and required accessories are not missing. Specifications can be checked by the model codes on the nameplate. Refer to Chapter 1.2 Specifications for the list of model codes.

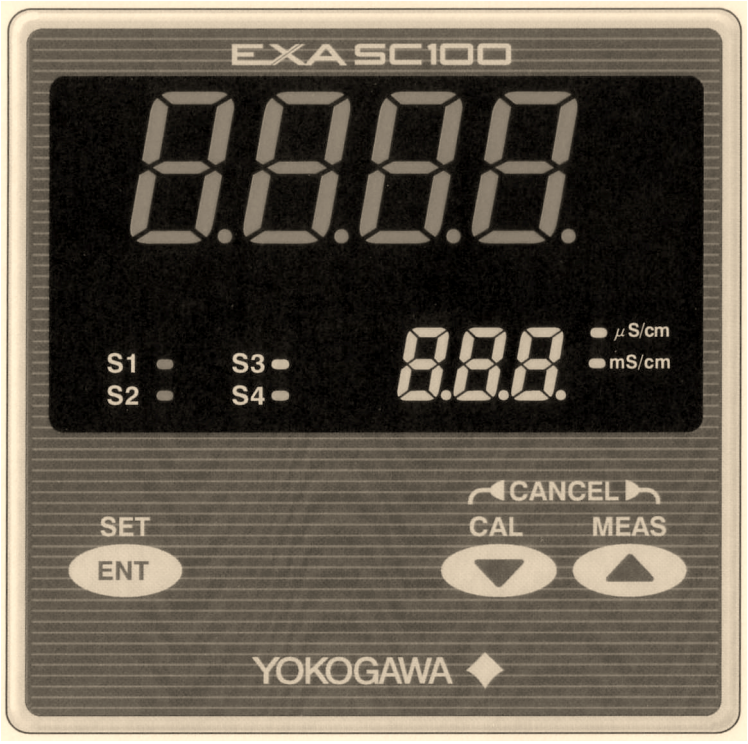
• Details on operation parameters

When the SC100 panel mount Conductivity Converter is operated without any key operation at the user site, it will work based on the operation parameters (initial data Table 5.1 to 5.3) set before shipping from the factory.

Ensure that the initial data is suitable for the operation conditions before conducting analysis. Where necessary, set the instrument parameters for appropriate operation. For details of setting data, refer to chapters 4 to 6.

When the operation parameters are changed, it is recommended to note down the changed setting data.

Front Panel of SC100



LED Display Symbols

• Alphanumerics are represented as follows on the LED display

Alphanumerics	LED Display	Alphanumerics	LED Display	Alphanumerics	LED Display
A		N		0	
B		O		1	
C		P		2	
D		Q		3	
E		R		4	
F		S		5	
G		T		6	
H		U		7	
I		V		8	
J		W		9	
K		X			
L		Y			
M		Z			

◆ After-sales Warranty

- For repair during the warranty period, carry or send the product to the local sales representative or service office. Yokogawa will replace or repair any damaged parts and return the product to you.
- Before returning a product for repair under warranty, give us information of the model name and serial number and a description of the problem. Any diagrams or data explaining the problems would also be appreciated.
- If we replace the product with a new one, we won't provide you with a repair report.
- Yokogawa warrants the product for the period stated in the purchase quotation. Yokogawa shall conduct warranty service based on its standard. When the customer site is outside of the service area, a fee for dispatching the maintenance engineer will be charged to the customer.
- In the following cases, customer will be charged for repair fee regardless of warranty period.
  - Failure of components which are out of scope of warranty stated in instruction manual.
  - Failure caused by usage of software, hardware or auxiliary equipment, which Yokogawa Electric did not supply.
  - Failure due to improper or insufficient maintenance by user.
  - Failure due to modification, misuse or outside-of-specifications operation which Yokogawa does not authorize.
  - Failure due to power supply (voltage, frequency) being outside specifications or abnormal.
  - Failure caused by any usage out of scope of recommended usage.
  - Any damage from fire, earthquake, storms and floods, lightning, disturbances, riots, warfare, radiation and other natural changes.
- Yokogawa does not warrant conformance with the specific application at the user site. Yokogawa will not bear direct/indirect responsibility for damage due to a specific application.
- Yokogawa Electric will not bear responsibility when the user configures the product into systems or resells the product.
- Our maintenance service and the supply of repair parts will be covered for five years after the production ends. For product repair, please contact the nearest sales office described in this instruction manual.

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1. Overview

1.1 EXA SC100 conductivity converter

The EXA SC100 conductivity converter is a panel-mount unit with built-in general-purpose preamp, large 4-digit LED display for measured value and 4-digit LED display for settings.

1.2 Check the specifications

The model code and suffix codes are shown below. Make sure that the supplied SC100 is the same as what you ordered.

Model	Suffix code	Option code	Description
SC100			Panel mount conductivity converter
– – – – –	-A		Always -A
Label language	-E		English
	-J		Japanese
Contact output	-21		2 contact outputs
	-41		4 contact outputs
– – – – –	-NN		Always -NN
Option	Unit	/UNT	S/m
	Construction	/65	IP65

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1.3 Features of the EXA SC100 conductivity converter

(1) Large 4-digit display. Both measured conductivity value and temperature can be displayed at the same time.

(2) You can select either two output contacts or four ; and you can select each contact output type from : high, low, high high, low low, and high high / low low.

(3) An isolated 4 to 20 mA analog output of measured value.

(4) The operation panel is rated for operation in an IP55. IP65 is optional.

(5) 96 mm x 96 mm DIN size panel-mount analyzer. Depth is 120 mm and weight is 600 g.

(6) Full set of self-diagnostic functions with indication of errors such as "out of measurement range", "converter abnormal", "calibration-time error".

1.4 Standard Specifications

Measurement: Conductivity of solution
Measuring range: 0.05mS/cm to 200 mS/cm
Note: Measuring range is defined by the sensor to be used. Maximum range of applicable sensors (SC10XB and SC4A) is 0 to 2.0 mS/cm.

Indication

Display: Digital (LED)
Range: 0.000mS/cm to 200.0 mS/cm
Indication: Conductivity reading, setting, status, temperature (range: -10 to 1108C)

Input signal

Conductivity input range:
Minimum: 5 mS/cm×K (K: cell constant)
Maximum: 50 mS/cm×K (K: cell constant)
Temperature input: Pt1000/Pt100
Temperature input range: -10 to 110℃

Transmission signal output

Number of output points: 1 point (for output of conductivity reading only)
Output signal: 4 to 20 mA DC, isolated
Load resistance: 600 Ω or less
Transmission signal range: Configurable within measuring range (initial setting : 0 to 200 μS/cm)
Minimum span: 0 to 0.2 mS/cm
Maximum span: 0 to 200 mS/cm
Note: Configurable range depends on the sensor to be used.
Maintenance output signal: Output hold "enabled/disabled" selectable
Hold output value: Last measured value/preset value (2.0 to 20.8 mA) selectable
Fail output signal: Downscale burndown (2 mA) "enabled/disabled" selectable

Contact output

Contact type : Relay contact output
Number of contacts : 2 or 4 outputs (must be specified when ordering)
Contact action : On/Off action
Contact functions : Selectable; High, low, high-high, low-low, high-high/low-low limit alarms, FAIL
Contact output hysteresis : 0 to 100% (configurable)
Contact output delay time : 0 to 200 seconds (configurable)

Contact rating :

When 2 contact outputs specified

S1 : 240 VAC 3A or 30 V DC 3A (resistance load), Form C (NC/NO/COM, 3 terminals)
S2 : 240 VAC 3A or 30 V DC 3A (resistance load), Form A (NO/COM, 2 terminals)

When 4 contact outputs specified

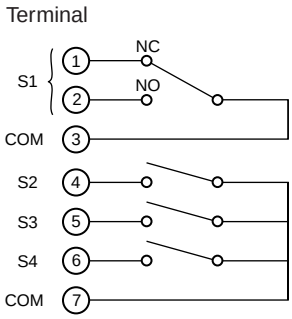
S1 : 240 VAC 3A or 30 V DC 3A (resistance load), Form C (NC/NO/COM, 3 terminals)
S2, S3, S4 : 240 V AC 3A or 30 V DC 3A (resistanceload), Form A, shared common
Maximum load current on common is 3A.

Contact status:

Table 1.1

Contact		Function selected					
		H, L, HH, LL, HH/LL limit alarms			FAIL		
		Power off	Power on		Power off	Power on	
			No alarm	Alarm		No alarm	Alarm
S1	NO-COM	Open	Open	Closed	Open	Closed	Open
	NC-COM	Closed	Closed	Open	Closed	Open	Closed
S2		Open	Open	Closed	Open	Closed	Open
S3 when specified		Open	Open	Closed	Open	Closed	Open
S4 when specified		Open	Open	Closed	Open	Closed	Open

Note: When a contact is activated, the LED on display panel turns on.



Ambient temperature : -5 to 45 ℃
Installation altitude: 2000 m or less above sea level
Storage temperature : -25 to 70 ℃
Ambient humidity : 10 to 90% RH, non-condensing
Construction : Front panel : Dust-proof and drip-proof construction IP55,
IP65 (when "/65" option specified)
Materials : ABS resin and polycarbonate
Case color : Black
Rated Power supply : voltage : 100 to 240 V AC (±10%), 50/60 Hz
Power consumption : Max. 9 VA
Weight : Approx. 600g
Dimensions : 96 (W) × 96 (H) × 120 (D) mm
Mounting : Panel mount
Panel cutout dimensions : 92 (W) × 92 (H) mm
Wiring : M3.5 screw terminal
Grounding : grounding resistance 100 Ω or less

Conformance to Safety and Standards

Conforms to IEC1010-1: 1990 and EN61010-1: 1992.

Certified for CSA1010.

The overvoltage category of each input is CAT II (IEC1010-1)

Certified for UL61010C. *l

*l

"Overvoltage category (Installation category)" describes a number which defines a transient overvoltage condition. It implies the regulation for inpulse withstand voltage.

" II " applies to electrical equipment which is supplied from the fixed installation like distribution board.

" I " applies to electrical equipment which is supplied from the circuit when appropriate transient overvoltage control means (interfaces) are provided.

Note: CSA, UL are pending.

Functional specifications

Reference temperature conversion: 0.00 to 10.00%/°C or NaCl coefficient compensation

Reference temperature setting range: 0 to 100°C

Cell constant setting range: 0.0001 to 12.00 cm^{-1}

Temperature value adjustment (cable length correction by temperature 1-point calibration)

Sensor cable length correction

Calibration function

Manual zero calibration (air calibration)

Span calibration (specified setting by specified solution, 1-point calibration)

Note: Temperature indication is available during manual calibration

Self-diagnostics function

FAIL output: Measuring range failure, temperature range failure, temperature sensor failure, converter failure, invalid temperature compensation

Error indication: Calibration value failure, abnormal temperature range during calibration, calibration solution measuring range failure

Converter performance: under normal operating conditions

Repeatability: ±1% of span

Note: Span refers to the one of input range.

Temperature reproducibility: ±1°C

Transmission output accuracy: ±0.3% of span

Note: Span refers to one of transmission signal output range.

Applicable sensors:

SC10XB Conductivity Sensor for SC100

Cable lenght : 3,5,10m

Extension cable length : up to 50m (Using the WTB100 terminal box)

Note : Extension cable length means that total cable length including sensor cable is within 50m

Wetted part materials :

In applying piping adapter : SUS316, polypropylene and rigid PVC resin (SC10XB) rigid PVC resin (adapter), Viton® fluoroelastomer (O-ring for adapter)

In applying drop-in-type : SUS316, polypropylene, ridid PVC resin, silicone rubber, PPS regin chlorinated polythylene rubber (for cable seath)

SC4A 2-electrode Conductivity Sensor

Note: Refer to document GS12D08F03-01E when using SC4A sensor.

2. Preparation for Operation

2.1 Unpacking

When the instrument arrives, unpack the package with care and check that the instrument has not been damaged during transportation. In addition, please check that the specification matches the order, and required accessories are not missing.

2.2 Choosing an Installation Location

WARNING

To minimize the danger of shock, the converter should be mounted on a panel for the converter when power is applied.

Cautions in choosing a mounting location

CAUTION

(1) Mount the converter in a location which allows adequate space for access from the rear for wiring and the like,
(2) Ideally the converter should be on the rear of a panel, so that unauthorized personnel will not have access to the terminals,
(3) The converter should be located in a place with minimal vibration,
(4) The converter should not be exposed to corrosive gas atmospheres,
(5) Temperature should be near normal (23 °C) with minimal change,
(6) Humidity should be between 10% and 90% RH,
(7) The converter should not be exposed to direct heat radiation,
(8) The converter should not be exposed to strong magnetic fields,
(9) The converter should not be exposed to water or moisture to be condensed,
(10) The converter should not be mounted near flammable materials,
(11) The converter should not be exposed to strong UV light.

The case of the converter is made of flam-retarded polycarbonate resin, and the bezel is flam-retarded ABS resin, so the converter should not be mounted above flammable materials.

If the converter is mounted near flammable materials against our caution, cover the converter by a plated steel plate at least 1.43 mm thick, or an uncoated steel plate of thickness 1.6 mm, separating the material from the converter top, bottom, left and right sides by a clearance of least 150 mm.

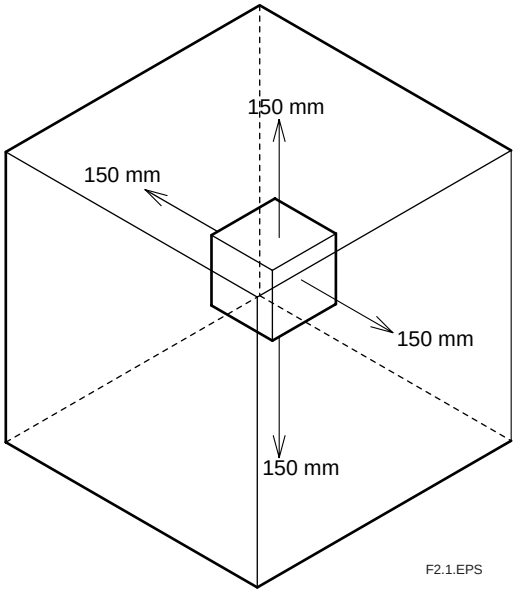


Fig. 2.1

2.3 External Dimensions

• SC100 Converter

Unit: mm

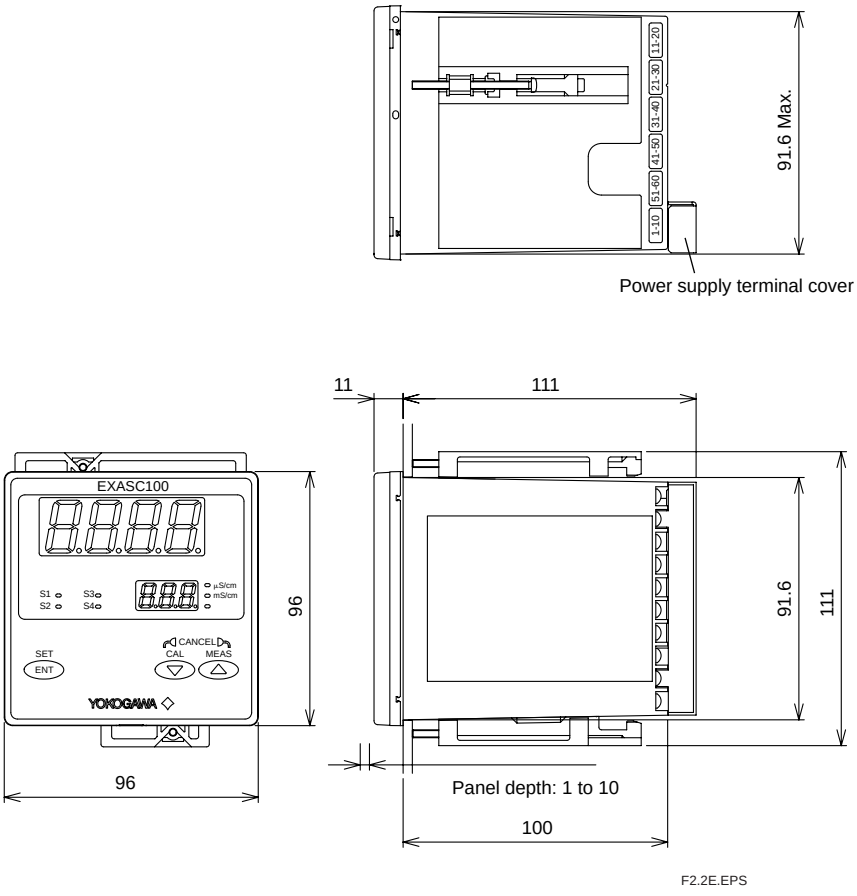


Fig. 2.2

2.4 Panel Cutout Dimensions

Unit : mm

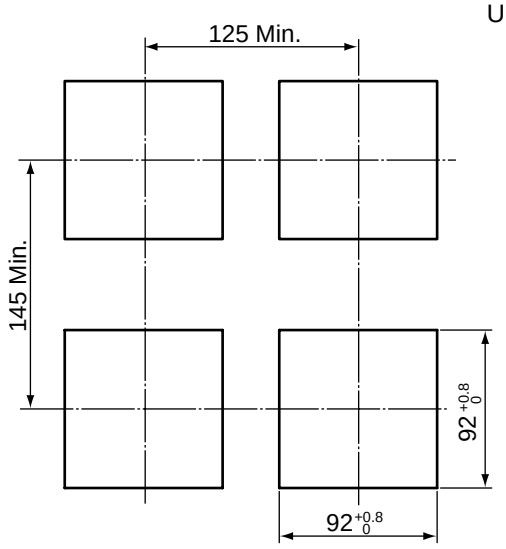


Fig. 2.3

2.5 Mounting

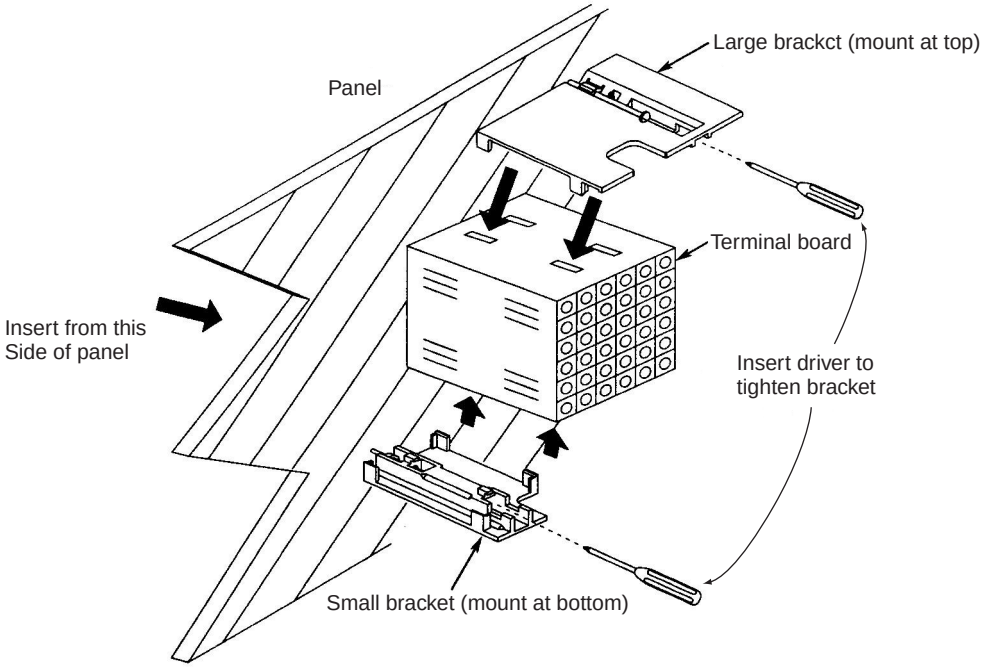


Fig. 2.4

Procedure 1

Cut panel out to mount the SC100 converter, referring to cutout dimensions shown on previous page.

Procedure 2

Insert the rear of the converter (terminal block side) in panel cutout.

Procedure 3

Mount top and bottom brackets (see figure) to fix the converter to panel.
*When detector output is to be prewired, refer to Sec. 3.4(2)

WARNING

When mounting the converter to the cutout, do not tightly fit them, do not force it because its case or mounting brackets may be damaged.

WARNING

Install the converter within below 30° from the line perpendicular to the panel board. Do not face the front of the converter upward.

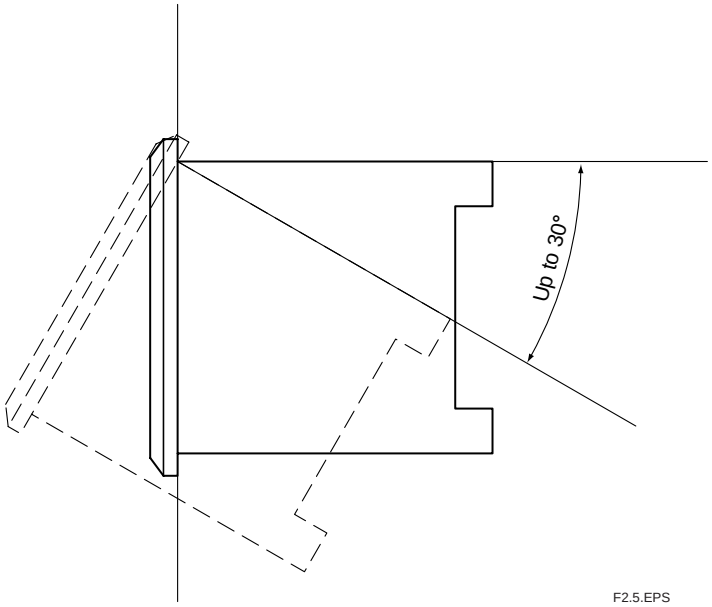


Fig. 2.5

3. Wiring

This section explains wiring of the EXA SC100 conductivity converter.

WARNING

Be sure to turn off power supply, and make sure, with a tester or the like, that the dangerous voltage is not applied to cable to be connected. Do not touch terminals if power be applied.

The recommended specifications for wiring terminals are shown below.
Use crimp-on terminals, designed to fit an ISO M3.5 screw, with an insulating sleeve.

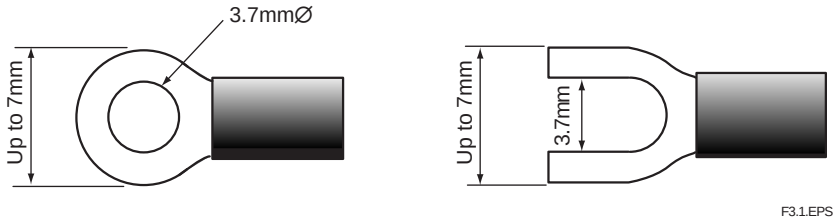


Fig. 3.1

Table 3.1 Recommended terminals

Maker	model	For wire size:	Tightening torque
Japan AMP Co., Ltd	1.25-YS3A	0.3~1.65mm	0.8N · m (8 kgf · cm) Up to or Iess
JST Co., Ltd	YD1.25-3.5		

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3.1 Direction of cable terminals fixing

When wiring cables to terminals on the rear of the instrument, put the cable terminals in the terminal face of the converter in such direction as to draw the cable to left side. (see Fig. 3.2)

CAUTION

There's a terminal wiring diagram on the nameplate on the side of the converter.

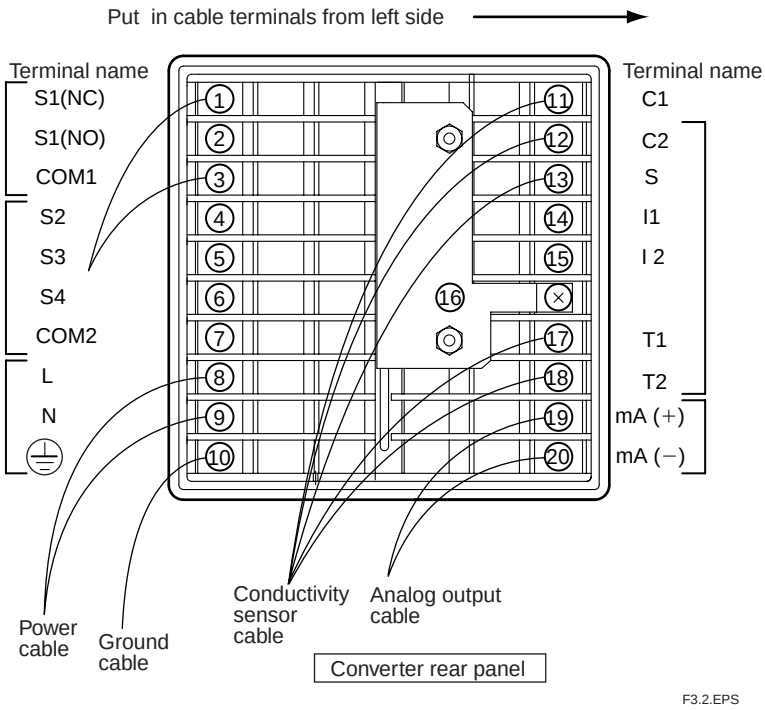


Fig. 3.2 Direction to put cable terminals

3.2 Noise prevention

●Noise sources

The following are typical sources of electrical noise

* Relays and contacts
* Solenoid coil, solenoid valre
* Solenoid coil, solenoid valve
* Power lines
* Inductive loads
* Inverters
* Motor commutators
* SCRs used for phase-angle control
* Wireless transmitters
* Welding equipment
* High-voltage ignition systems

●Noise prevention

When wiring, take the following precautions to minimize the effects of noise:

* Keep input circuit wiring as far as possible from power or ground wiring.
* Shielded wires are effective for minimizing pickup of noise from electrostatic induction.
  If neccessary, connect the shield to the ground terminal.
  Avoid double-point grounding, though.
* Twisted wires for input are effective in minimizing pickup of noise from electro-magnetic induction.

3.3 Wiring Terminal Diagram

There are wiring terminals on the rear of the SC100 converter. Wire to terminals 1 to 10 and terminals 11 to 20 as shown in Fig. 3.3. The terminal block cannot be removed.

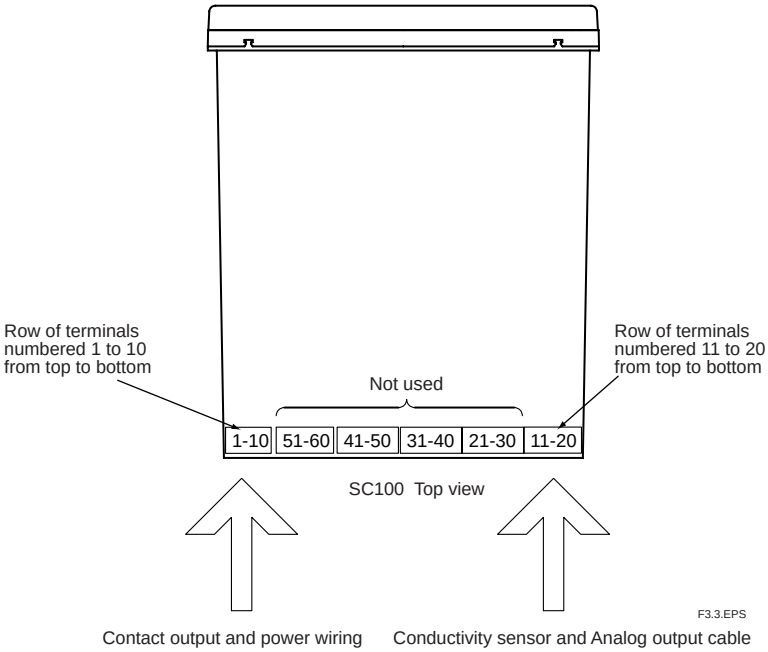


Fig. 3.3 Cable wiring position

3.3.1 Use of EXA SC100 in combination with the SC10XB dedicated conductivity sensor

CAUTION

Screws on terminals are ISO M3.5. There's a terminal wiring diagram on the converter nameplate on the side of the converter.

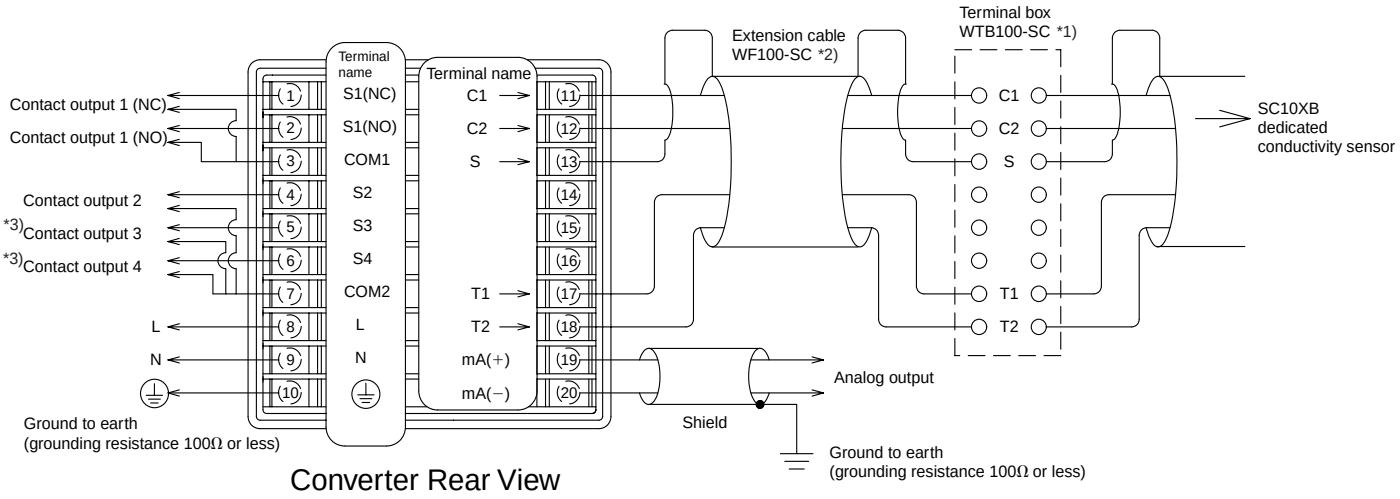


Fig. 3.4 Wiring diagram when the WTB100 terminal box is used

*1) The terminal box WTB100 is used when conductivity converter and conductivity sensor are far apart.

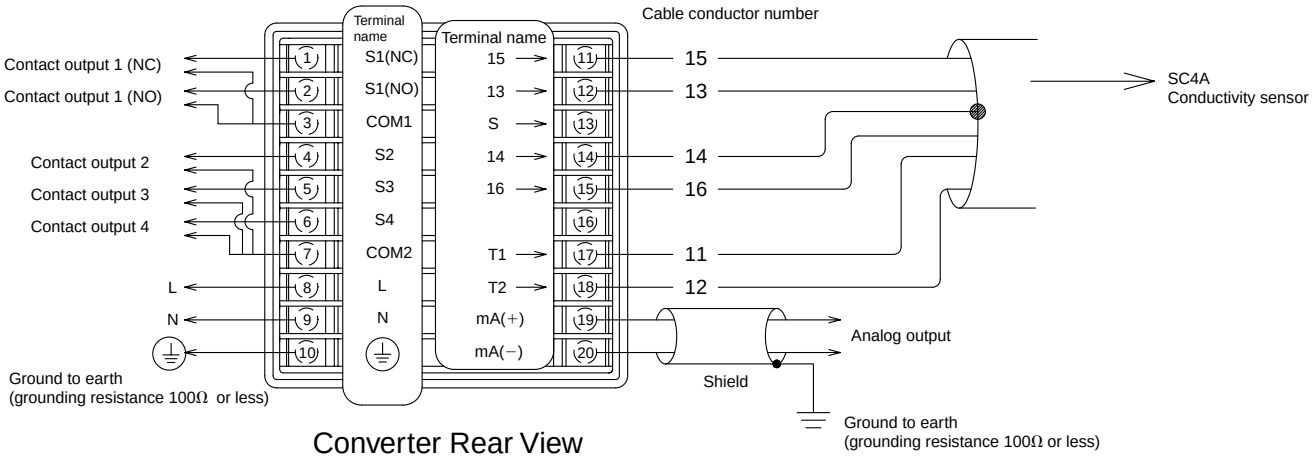
*2) The extension cable WF100 is used when conductivity converter and conductivity sensor are far apart.

*3) When only two contact outputs are specified, contact outputs 3 and 4 (S3 and S4) are not used. When four contact outputs are used, S3 and S4 share the same common lead (COM2).

3.3.2 Use of EXA100 in combination with the SC4A conductivity sensor

CAUTION

Screw on terminals are ISO M3.5. There's a terminal wiring diagram on the nameplate on the side of the converter.



Note: Terminals are M3.5 screws. Terminal diagram is shown on the name plate on the side of the converter.

Fig. 3.5 Wiring diagram when intermediate terminal box is not used

In this combination, the WTB terminal box is also applicable.
When using the terminal box, refer to the terminal box Instruction manual.

Table 3.2 Terminal wiring example

Terminal no.	Signal name	Signal description
1	S1(NC)	Contact output 1 (relay contact) NC
2	S1(NO)	Contact output 1 (relay contact) NO
3	COM1	Contact output 1 (common)
4	S2	Contact output 2 (relay contact)NO
5	S3	Contact output 3 (relay contact) NO
6	S4	Contact output 4 (relay contact) NO
7	COM2	Contact output 2 (common) (shared by S2, S3 & S4)
8	L	Power line L
9	N	Power line N
10	⏚	Protective Ground
11	C1	Inner electrode terminal (for SC10XB and SC4A)
12	C2	Outer electrode terminal (for SC10XB and SC4A)
13	S	Electrode shield terminal
14	I1	Outer electrode terminal (for SC4A)
15	I2	Inner electrode terminal (for SC4A)
16	−	Reserved
17	T1	Temperature input terminal
18	T2	Temperature input terminal
19	mA(+)	Analog output terminal (+)
20	mA(−)	Analog output terminal (−)

T3.2.EPS

CAUTION

Figures 3.4 and 3.5 seem to indicate that cable can be pulled in from right hand side, but in fact cable can only be pulled in from left hand side as described in Sec. 3.1

3.4 Conductivity sensor detector wiring

This section describes connection of the SC10XB or the SC4A conductivity sensor to the EXA SC100 conductivity converter.

CAUTION

For a description of how to connect these sensors via extension cable and terminal box, refer to the related documents : No. IM 12B11E01-01E for the EXA WTB100 terminal box, and refer to No. IM 12B11F01-01E for the EXA WF100 extension cable.

3.4.1 Connection of the SC100 converter and the SC10XB conductivity sensor

Connect the conductivity sensor (detector) by cable to the terminals. The correct combination to coonnect is listed below:

Conductivity converter terminal no.	Cable core color and code for SC10XB sensors
11	White (C1)
12	Brown (C2)
13	Green (S)
14	Do not use
15	Do not use
16	Do not use
17	Red (T1)
18	Black (T2)

3.4.2 Connection of SC100 converter and SC4A conductivity sensor

Connect the sensor to the terminals as listed below.

Conductivity converter terminal no.	Cable core color code forSC4A sensor
11	Black (15)
12	Green (13)
13	Do not use
14	Yellow (14)
15	Pink (16)
16	Do not use
17	White (11)
18	Black (12)

CAUTION

Since SC4A cable core numbers do not agree with converter terminal numbers, take care to connect.

3.5 Wiring the WF100 Extension Cable

When the EXA SC100 conductivity converter is too far to connect directly the conductivity detector, use the EXA WTB100 terminal box and EXA WF100 extension cable connect them, following the section 3.4.1.

3.6 Output Signal Cable Wiring

DANGER

To minimize the danger of shock, cut the power supply to the converter before connecting or disconnecting wires of output signal to an instrument such as a recorder.

The output signal wiring from the SC100 converter connects to recorders or the like. Use two-core shielded cable for this wiring.

(1) Connect output signalcables to the terminals. Connect the cable to the recommended terminal as show in Fig. 3.1.
Before connecting, remove the core wire covering in a correct length suitable for crimping the terminal.

(2) As shown in Figures 3.4 and 3.5 of Section 3.3, ground to earth and ground connection at one point only.

3.7 Contact output wiring.

3.7.1 Wiring when S1 is used

A terminal cover plays a role in reducing the risk of electric shock when power is applied. When connecting contact output wiring, loosen the two screws to remove the cover. After completing the wiring, fix the cover again.

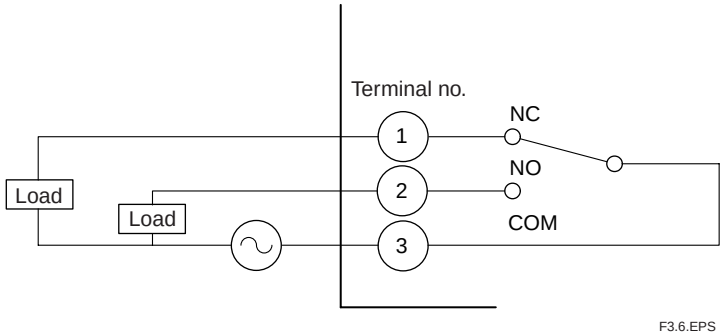


Fig. 3.6 Relay contact output wiring

* If a load exceeds the contact rating (switch capacity : 240VAC 3A, 30VDC 3A), a slave relay needs using.
* Output contacts have a limited life.
No use of such an inductive load as a slave relay or a solenoid valve can cause malfunction or fault of the contacts.
Don't fail to connect a CR filter (in use of AC voltage) or a diode (in use of DC voltege) in parallel with the contacts.

WARNING

* Be sure to cut power to the converter before removing the terminal cover. To avoid the danger of shock, turn off power and confirm that terminals are not live before wiring. Never touch the terminals when power is applied.

Table 3.3 Recommended CR filters

Maker	Models
MATSUO Electric co.,Ltd	CR UNIT 953, 955 etc.
SHIZUKI Electric co.,Ltd	SKV, SKVB etc.
RUBYCON Corporation	CR-CFS, CR-U etc.

T3.3.EPS

• For an DC relay

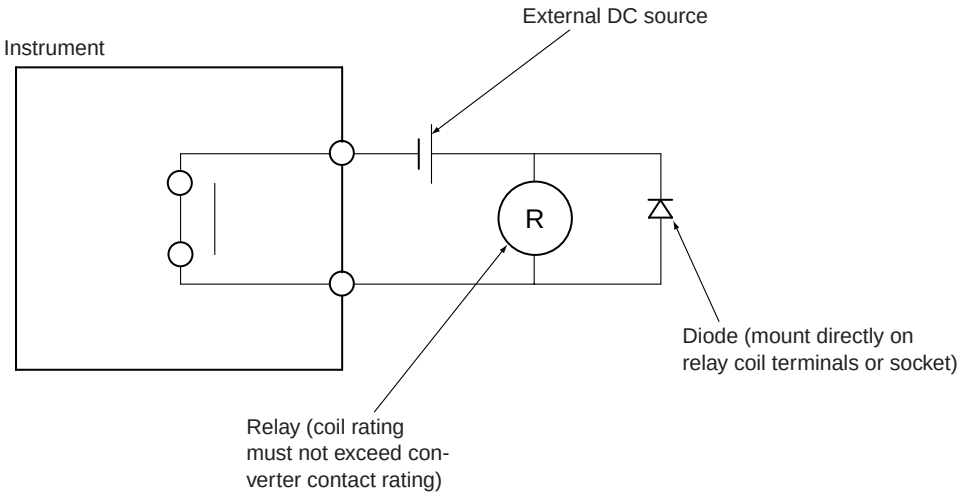

External DC source
Instrument
R
Diode (mount directly on relay coil terminals or socket)
Relay (coil rating must not exceed converter contact rating)
F3.7.EPS

Fig. 3.7

• For an AC relay

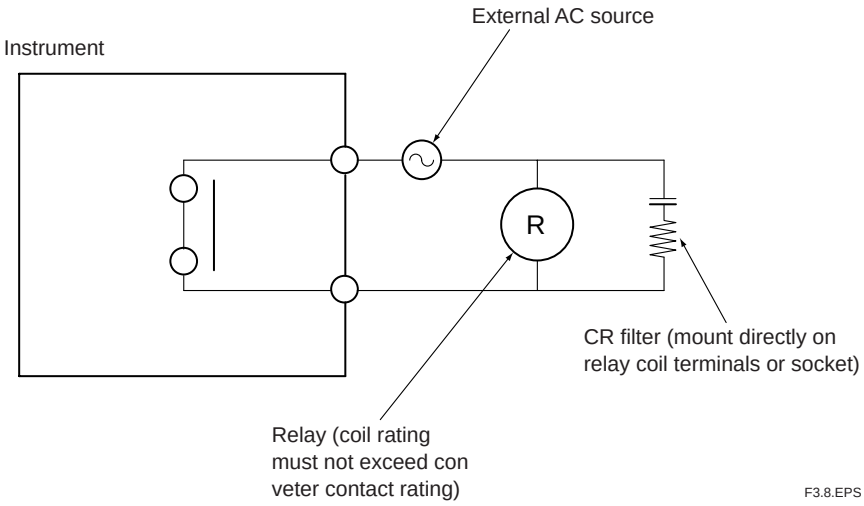

External AC source
Instrument
R
CR filter (mount directly on relay coil terminals or socket)
Relay (coil rating must not exceed converter contact rating)
F3.8.EPS

Fig. 3.8

3.7.2 Wiring for S2 (for two-contact-output specification) or S2, S3 and S4 (for four-contact output specification)

A terminal cover plays a role in reducing the risk of electric shock when power is applied. When connecting contact output wiring, loosen the two screws to remove the cover. After completing the wiring, fix the cover again.

(1) If a load exceeds the contact rating (switch capacity : 240VA 3A or 30VDC 3A) use a slave relay as shown in Sec. 3.7.1.

(2) If switching a very small current, connecting a bleeder resistor in parallel with the load can improve contact reliability.

(3) Output contact have a limited life : about 100.000 switching operations with a resistive load, typical.
Don't fail to connect a CR filter (in AC voltage use) or a diode (in DC voltage use).

(4) Connect the cable to the recommended terminal as show in Fig.3.1.
Before connecting, remove the wire covering in a correct length suitable for crimping the terminal.

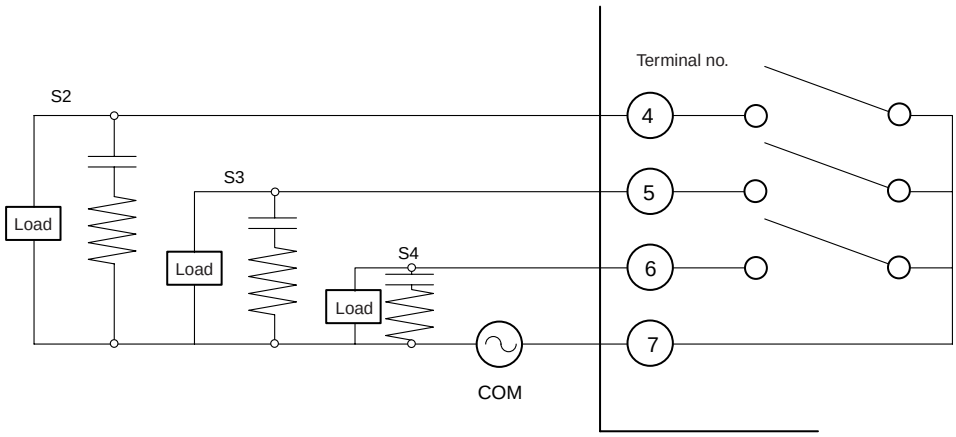


Fig. 3.9

WARNING

* Be sure to cut power to the converter before removing the terminal cover. To avoid the danger of shock, turn off power and confirm that terminals are not live before wiring. Never touch the terminals be touched when power is applied.

3.8 Power and Ground Wiring

* Power: This wiring should connect a power source of the correct voltage and frequency to the EXA SC100 Conductivity Converter. The power wiring should be heavy vinyl sheath cable rated at 600V insulation resistance (specifications equivalent to JIS C 3307).
* Ground: Ground to earth (ground resistance 100 ohms or less). Use a sufficiently heavy cable (cross sectional area of 2 mm^2 or greater, nominal).
* Use the recommended terminals to terminate connecting cables, and make sure that they are the correct size to match the cable core diameter.

A terminal cover is fitted to reduce the risk of electric shock when power is applied. When connecting contact output wiring, you need to loosen the two cover screws to remove the cover. After completing the wiring, take care not to forget to replace the cover.

WARNING

* Be sure to cut power to the converter before removing the terminal cover. To avoid the danger of shock, turn off power and confirm that terminals are not live before wiring. Never touch the terminals be touched when power is applied.

CAUTION

The EXA SC100 conductivity converter does not have a power switch built in. You should add an on-off switch with two poles (to disconnect both sides of the power line).

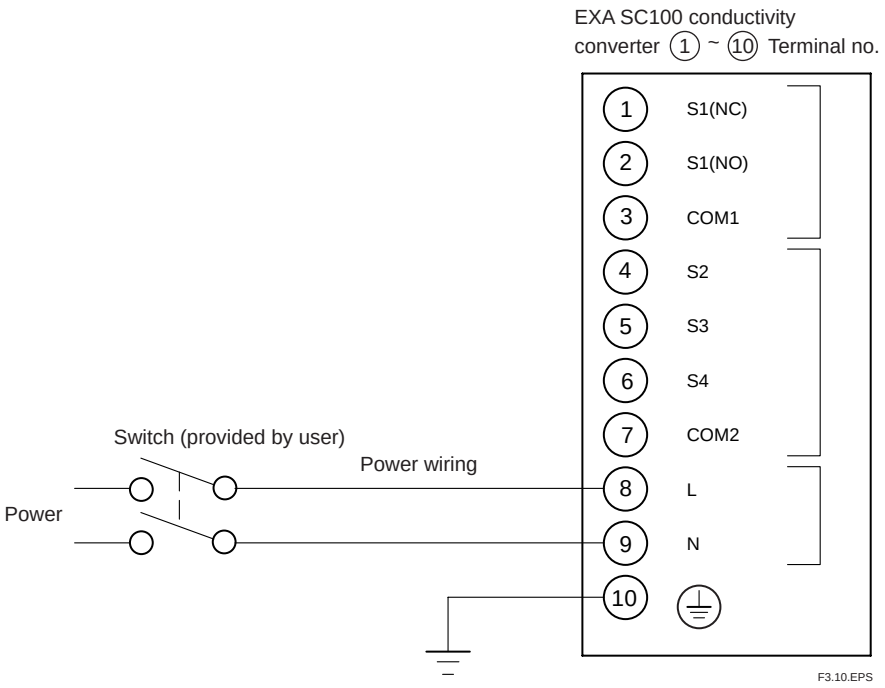


Fig. 3.10

4. Overview of Operation Panel

4.1 Overviews of names and functions of operation panel keys

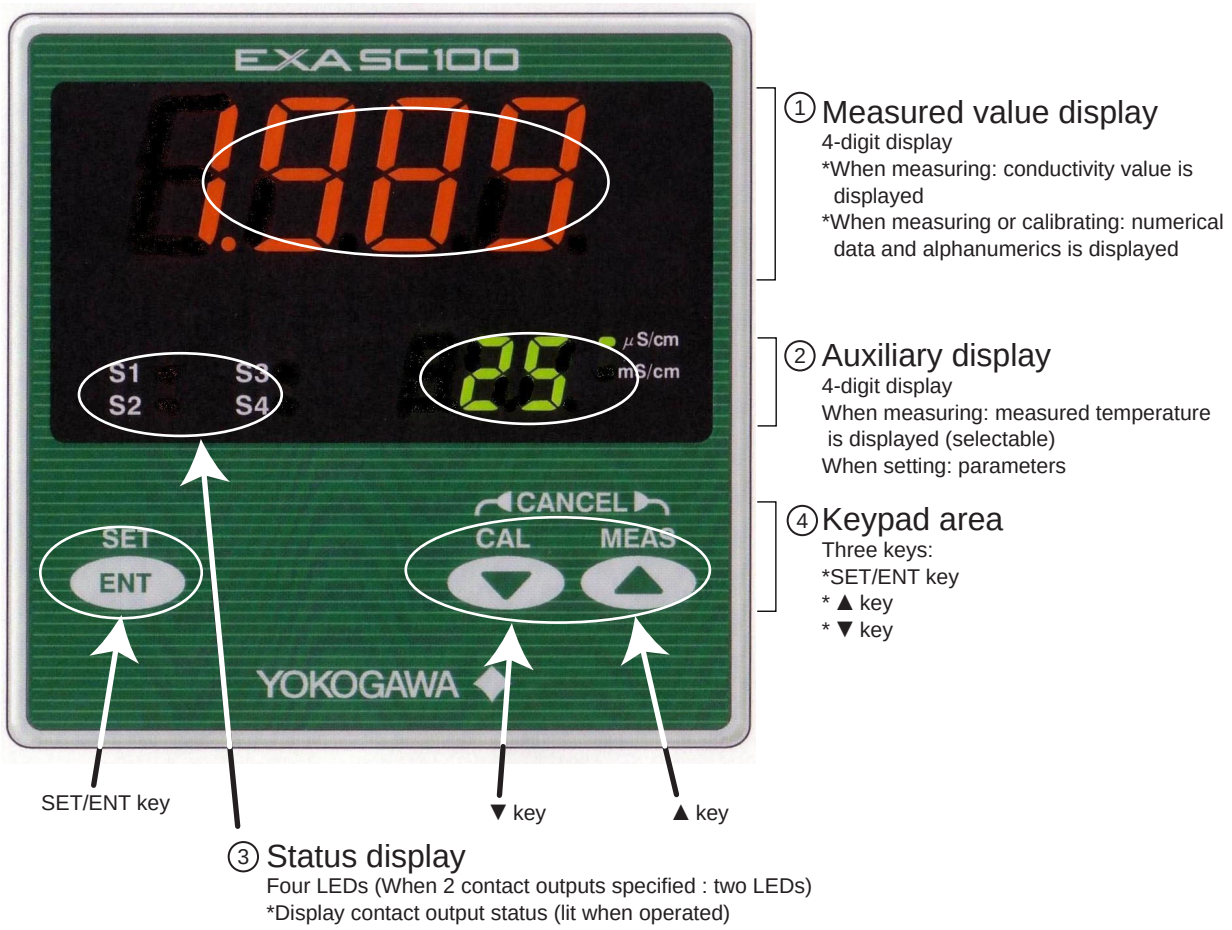


Fig. 4.1

4.2 Key Operation

On the EXA SC100 front panel there are three keys for screen/mode switching and data entry.

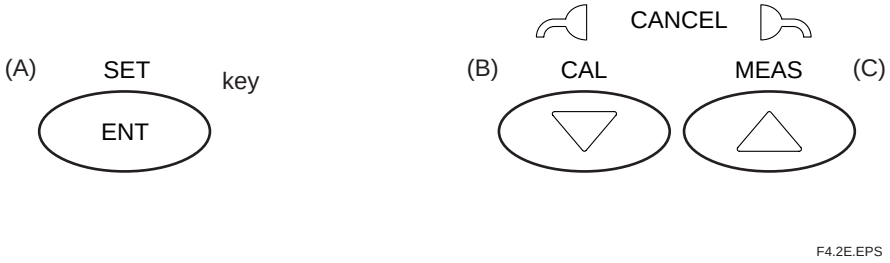


Fig. 4.2 Layout of three keys on front panel

Main uses of these keys are as follows:

(A) SET/ENT key: Use to confirm mode changes and data settings
* At the measurement mode, if you press it continuously for at least three seconds, the data setting screen is displayed.

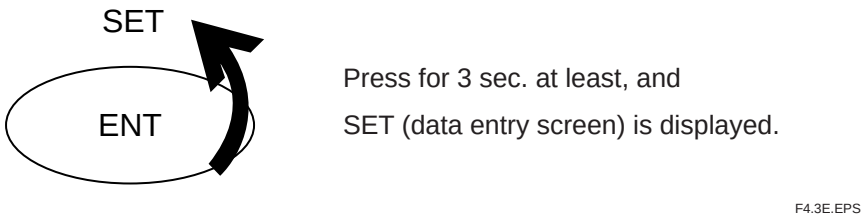


Fig. 4.3

(B) (▼) key: Use to select different menu item or reduce data setting value.
* Pressing this key for at least three seconds switches to the calibration screen.

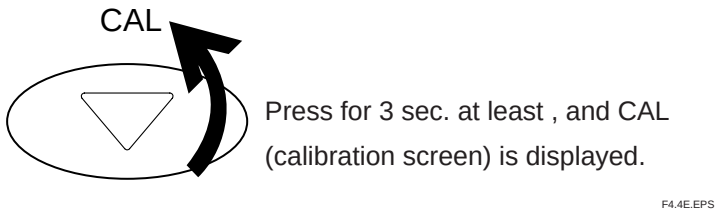


Fig. 4.4

(C) (▲) key: Use to select different menu item or increase data setting value.
* Pressing this key for at least three seconds in calibration or data setting top mode return to the measurement mode.

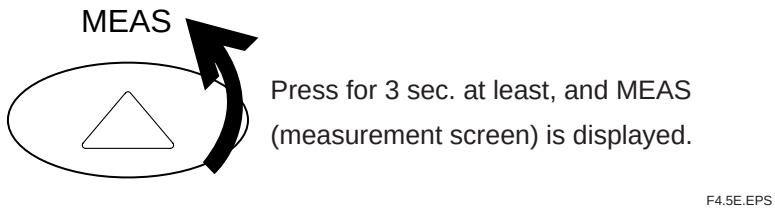


Fig. 4.5

(D) Operation cancel
* Pressing both (▼) and (▲)) screen simultaneously cancels operations

4.3 Switching mode to Displated

EXA PH100 has three menu screens: measurement, calibration and data setting screens. The screen transition diagram is shown below.

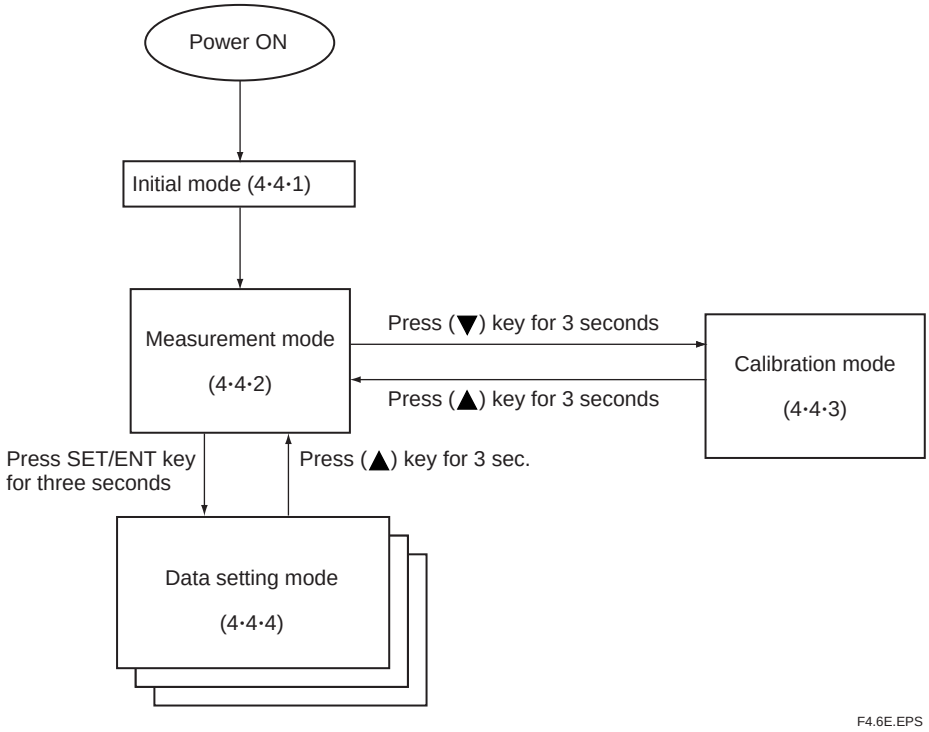


Fig. 4.6

4.4 Display examples

4.4.1 Display in Initial model

Display when the SC100 converter is normal.
(1) All LEDs are lit when the converter is powered on.

F4.7E.EPS

Fig.4.7. All LEDs lit

(2) Then all LEDs turn off.

F4.8E.EPS

Fig.4.8. All LEDs off

(3) Move to measurement mode

Note:
" – – – –" is displayed on measured value display portion in case of unstable measured value.

Fig. 4.9 Measurement mode with temperature display

4.4.2 Display in Measurement mode

1) Display in Measurement mode

* Measurement display: Displays conductivity value.
  The position of Decimal point automatically moves among four-digit numbers.
* Auxiliary display:
  When temperature display functions are enable, the temperature and units (C for ℃, F for ℉) are displayed. When temperature display functions are unenable, nothing is displayed. (The initial setting is for no temperature display).

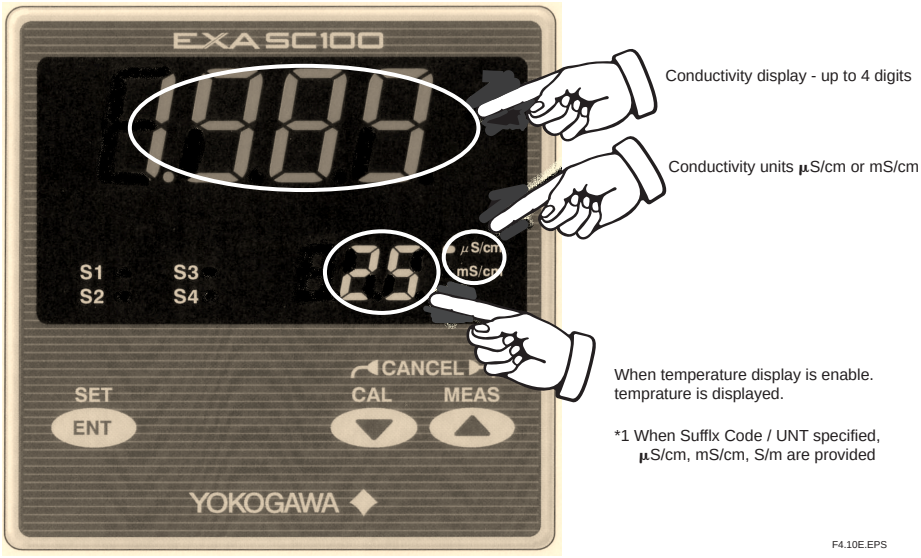


Fig. 4.10

4.4.3 Calibration mode

(1) Switching From Measurement mode

Press (▼) key for 3 sec. to transfer to Calibration mode

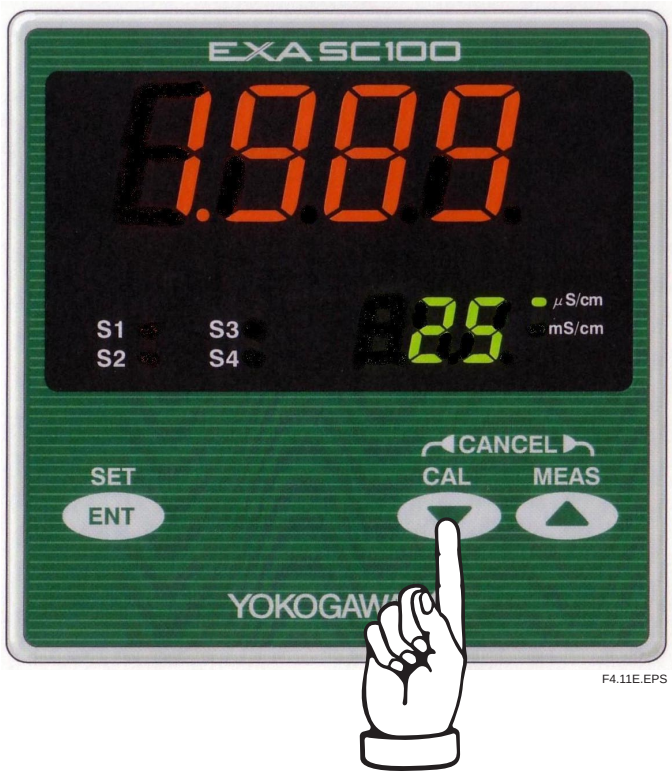


Fig. 4.11 Measurement mode

(2) Calibration mode

Fig. 4.12 Calibration mode (for Autocalibration mode)

Press (▲) for at less 3 sec. to return to Measurement mode

4.4.4 Setting mode

(1) Measurement mode display

Press SET/ENT key for at least 3 sec. to transfer to Setting mode.

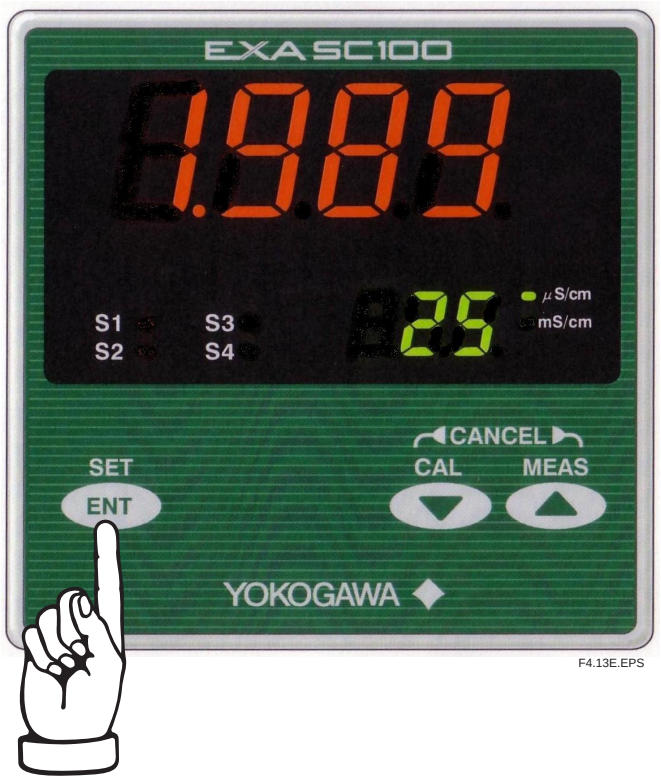


Fig. 4.13 Measurement mode

(2) Setting screen

Fig. 4.14 Setting mode

Press (▲) for at less 3 sec. to return to Measurement mode

5. Operation

5.1 Start up

5.1.1 Check wiring

Check that all wiring is correct (refer to Sec. 3.3)

5.1.2 Start up Conductivity Converter

Apply power (100 to 240V AC ± 10% 50/60Hz) to EXA SC100 conductivity converter.

5.1.3 Data Setting

Set the following parameters after switching the Data setting mode -- (1) analog output parameter, (2) calibration parameters, (3) alarm settings, and (4) other parameters -- in the order listed, to enable desired operation for process conductivity control:

(1) Analog output parameters

"Ao.PA", at the analogue output parameters setting mode, is displayed on the Measured Value display area.
This mode is for user setting of analogue-output-related settings

(2) Alarm parameters (Page 5-4, 5-5)

"Alrm", at the calibration parameters setting mode, is displayed on the Measured Value display area.
This screen is for user setting of alarm-related settings

(3) Other parameters

"otHr", at the calibration parameters setting mode, is displayed on the Measured Value display area.
This mode is for user setting of parameter settings other than (1) to (2) above.

Note

See Sec. 4 "Overview of Operation Manual" and table of LED display symbols in preface to this manual.

(1) Analogue output parameter setting mode ("Ao.PA" is displayed at top of screen)

This mode is for user setting of analog-output-related settings. A list of menu options on this mode is shown below:

Table 5.1

Letters displayed	Parameter	Setting range	Initial value	Note
Ao.PA	Menu Title	NA (not applicable)	NA	
rH	Upper limit Range	0.2 μS/cm to 200.0 mS/cm (*1) (0.02 mS/cm to 20.00 mS/m)	200.0 μS/cm (20.00 mS/cm)	Decimal point and conductivity unit is set first. After this, upper limit is set. (*2)
M.HLd	Hold during Maintenance	0 : No Hold 1 : Hold 2 : Set value	1 : Hold	
H.Ao	Hold output setting	2.0 ~ 20.8mA	2.0	
F.HLd	Hold if abnormal	0 : No Hold 1 : Burn out down scale (2mA)	1 : Burn out down scale (2mA)	

T5.1E.EPS

*1: It is possible to input 0.19 μS/cm or less with key, but this value is not set and does not become valid.

*2: For instance, when trying to set 20 μS/cm without moving the decimal point position, the setting can be not "20.00 μS/cm" but "20.0 μS/cm".; you cannot set a value to the second decimal place.
For this reason, in case of inputting "19.99 μS/cm" as an example, setting the decimal point and conductivity unit must be set before inputting conductivity value.
Otherwise, you cannot help inputting "20.0 μS/cm", rounding off "19.99 μS/cm".

Example flow chart for analog output parameter setting is shown below

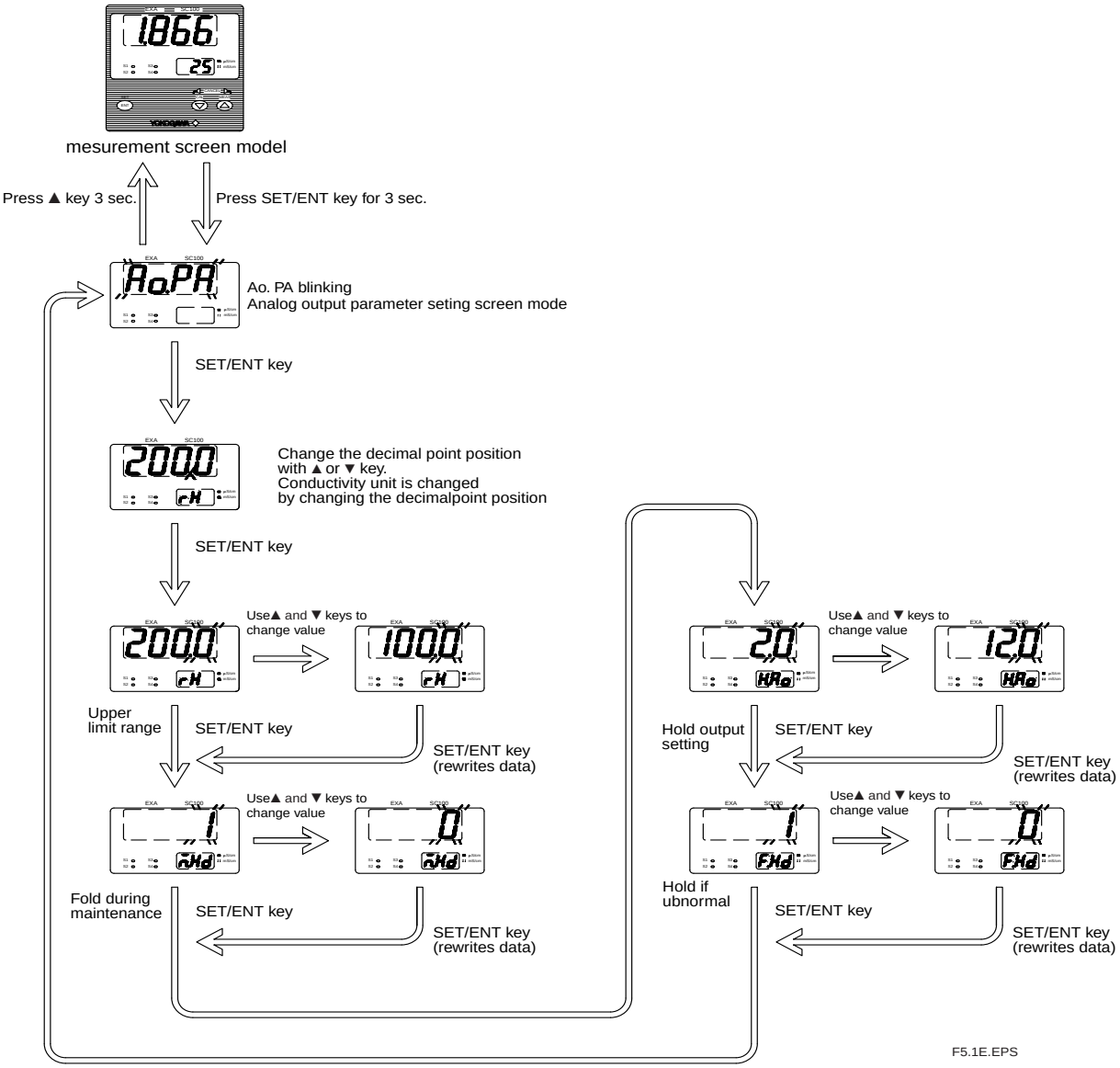


Fig. 5.1 Example flow chart for analog output parameter setting

* Note: To cancel, press both (▼) and (▲) simultaneously.

(2) Alarm parameter setting mode ("Alrm" is displayed at top of screen)
This mode is for user setting of alarm data. A list of menu options on this mode is shown below:

Table 5.2

Letters displayed	Parameter	Setting range	Initial value	Note
Alrm	top menu	NA (not applicable)	NA	
S1	S1	0: high limit alarm 1: low limit alarm 2: high high limit alarm 4: high high limit/low low limited alarm 5: abnormal	0: high limit alarm	
HY1	S1 hysteresis	0-100 %	2 %	
dL1	S1 delay time	0-200 seconds	0	
S2	S2	0: high limit alarm 1: low limit alarm 2: high high limit alarm 4: high high limit/low low limited alarm 5: abnormal	1: low limit alarm	
HY2	S2 hysteresis	0-100 %	2 %	
dL2	S2 delay time	0-200 seconds	0	
S3	S3	0: high limit alarm 1: low limit alarm 2: high high limit alarm 4: high high limit/low low limited alarm 5: abnormal	2: high high limit alarm	when suffix code is -21, S3 does not appear
HY3	S3 hysteresis	0-100 %	2 %	when suffix code is -21, HY3 does not appear
dL3	S3 delay time	0-200 seconds	0	when suffix code is -21, dLY3 does not appear
S4	S4	0: high limit alarm 1: low limit alarm 2: high high limit alarm 3: low low limit alarm 4: high high limit/low low limited alarm 5: abnormal	3: low low limit alarm	when suffix code is -21, S4 does not appear
HY4	S4 hysteresis	0-100 %	2 %	when suffix code is -21, HY4 does not appear
dL4	S4 delay time	0-200 seconds	0	when suffix code is -21, dLY4 does not appear
H.A	high limit alarm	0.000 **µ**S/cm - 200.0 mS/cm (0.0 **µ**S/m - 20.00 S/m)	200.0 **µ**S/cm (20.00 mS/m)	
L.A	low limit alarm	0.000 **µ**S/cm - 200.0 mS/cm (0.0 **µ**S/m - 20.00 S/m)	0.000 **µ**S/cm (0.0 **µ**S/m)	
HH.A	high high limit alarm	0.000 **µ**S/cm - 200.0 mS/cm (0.0 **µ**S/m - 20.00 S/m)	200.0 **µ**S/cm (20.00 mS/m)	
LL.A	low low limit alarm	0.000 **µ**S/cm - 200.0 mS/cm (0.0 **µ**S/m - 20.00 S/m)	0.000 **µ**S/cm (0.0 **µ**S/m)	

T5.3.EPS

Example of flow chart for alarm parameter setting is shown below

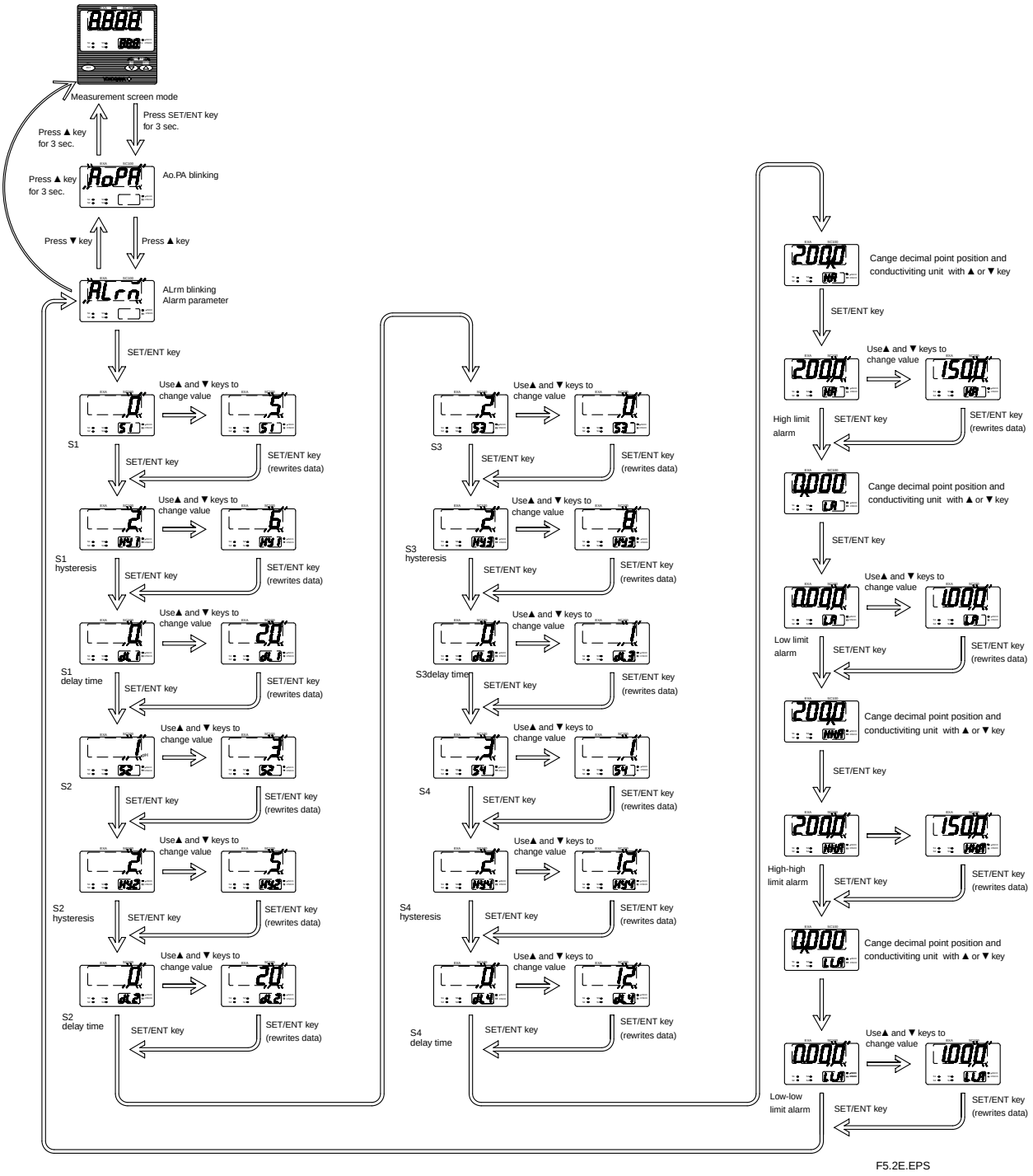


Fig. 5.2 Example of flow chart for alarm parameter setting

* Note: To cancel, press both (▼) and (▲) simultaneously.

(3) Other parameter setting mode ("other" is displayed at top of screen)

This mode is for user setting of other measurement parameter. A list of menu options on this mode is shown below:

Table 5.3

Letters displayed	Parameters	Setting range	Initial Value	Note
otHr	Menu title	–	–	
C.C	Cell constant	0.0001~12.00 cm^{-1} (*1)	1.00	Set the decimal point and conductiving unit first. After this, set the numbers.
Cb.r	Wiring resistance	0.00~50.00Ω	0.00Ω	
dP.t	Temperature display	0: OFF 1: ON	0: OFF	
Unt	Temperature Unit	0: °C 1: °F	0: °C	
t.Sn	RTD type	0: Pt1000 1: Pt100	0: Pt1000	
t.CL	Temperature Calibration	-15.0~115.0 °C (*2) (5.0~239.0 °F)	For your reference, intial temperature is displayed as what has been measured right after switchig temererature calibration mode. In addition, Once the templerature is displayed, the temperature keops constant even though measurement value changes.	with ▲ or ▼ key, actual temperature of measurement sample. Temperature measurement error is corrected by this operation.
S.tC	Temperature Compensation	0: Temperature Cofficient 1: NaCl	0: Temperature Cofficient	
St.t	Standard temperature	0~100°C (14~230 °F)	25°C (77 °F)	
t.Co	temperature coefficient	0.0~10.00 %/°C (0.0~18.00 %/°F)	0.00° (0.00 %/°F)	
d.InS	InsP menu display flag setting	0: no display 1: display	0: no diaplay	Always set "0". when the power is turned off, the setting become "0".

T5.3.EPS

(*1) When no decimal point is displayed, setting range is 0.0001-0.0999 cm^{-1} (display 0001-0999)
When 3 digits below dec. pt., setting and display ranges are 0.001-0.999 cm^{-1}
When 2 digits below dec. pt., setting and display ranges are 0.01-12.00 cm^{-1}

(*2) Actual liquid temperature entered may be in the range —20.0 to +5.0…C relative to displayed value.
If RTD is changed, display may change to [- - - -]

Example of flow chart for setting other measurent parameters is shown below

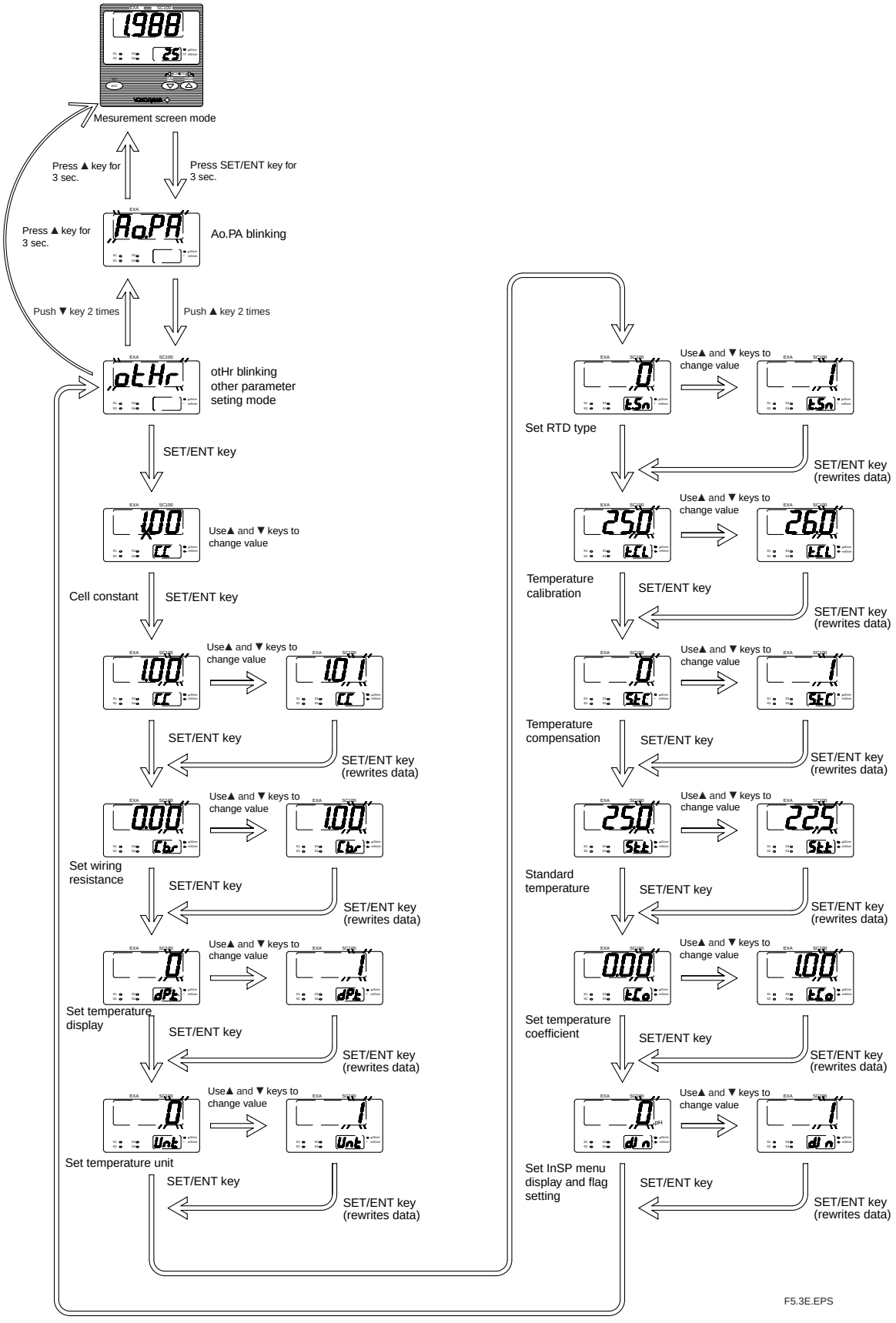


Fig. 5.3 Example flow chart for setting other measurement parameters

Note: To cancel, press both (▼) and (▲) simultaneously.

5.1.4 Preparation for Operation

When using the EXA SC100 conductivity converter together with a conductivity detector, perform initial setup and calibration as follows:

(1) Carefully set correct cell constant as described in Sec. 6.1

(2) Perform wiring compensation
As described in Sec. 6.2, set wiring resistance and perform temperature calibration.

(3) Zero calibration (in air)
As described in Sec. 6.3, perform zero calibration (in air).

(4) Calibration with standard solution
Normally, in start-up, it is not necessary to calibrate with standard solution

5.2 Test Operation

Monitor the EXA SC100 conductivity converter in test- operation mode for a while, in order to confirm it normally works.

5.3 Normal Operation

From the parameter setting screen mode, press the (▲) key for at least 3 seconds to return to the measurement screen.

Apart from when changing settings or calibrating with standard solution, this converter doesn't need operating during normal operation. If an error message is displayed or the output scales out, referring to Sec. 8 for troubleshooting, find clearly the cause and solve problems immediately.

In addition, be sure to perform the daily checks and maintenance described in Sec. 7 in order to maintain reliable operation.

5.4 Stopping and Restarting Operation

Turn simply off the power supply to stop operation.

However, in case of changing settings, be sure to wait at least 2 seconds from this changing before turning off the power. In other cases, no special precautions are required.

To restart operation, simply restore power. The parameter values remain the same as before the power failed.

6. Settings

6.1 Setting Cell Constants

The EXA SC100 conductivity converter is used with the dedicated SC10XB conductivity sensor or with the SC4A conductivity sensor; before use it is necessary to enter the cell constant marked on the cell or the cable. Even for the same type of conductivity sensor the cell constant varies from cell to cell. You need to enter the cell constant into the converter before using it.

6.1.1 How to set cell constant

Set cell constant as follows:

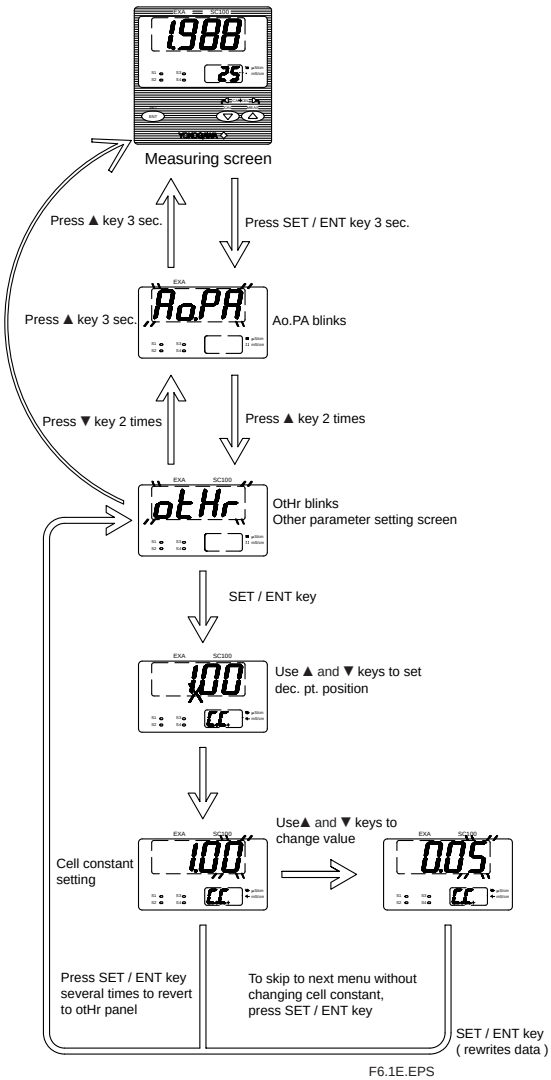

Measuring screen
Press ▲ key 3 sec.
Press SET / ENT key 3 sec.
Press ▲ key 3 sec.
Ao.PA blinks
Press ▼ key 2 times
Press ▲ key 2 times
OtHr blinks
Other parameter setting screen
SET / ENT key
Use ▲ and ▼ keys to set dec. pt. position
Use▲ and ▼ keys to change value
Cell constant setting
Press SET / ENT key several times to revert to otHr panel
To skip to next menu without changing cell constant, press SET / ENT key
SET / ENT key (rewrites data)
F6.1E.EPS

Fig. 6.1

6.1.2 Cell Constant

The default cell constant value is preset to 1.00 cm^{-1} in the converter at shipping-time. Before use, change to the cell constant value of the conductivity sensor to be used, as described in Sec. 6.1.1.

6.1.3 Cell Constant Retention

The cell constant stored in the conductivity converter is retained even when power is turned off. If the associated conductivity sensor is changed or replaced, then the cell constant in the converter must be updated accordingly.

6.2 Temperature Compensation Setting

The conductivity is affected by solution temperature - usually the effect of temperature on conductivity is 2% per °C temperature change. However the effect depends on solution composition, concentration, and measurement temperature span, so compensation is determined based on these factors. The coefficient **α** represents the % change in conductivity for a 1°C temperature change.

Most of applications need to monitor or measure concentration change of solution without the influence of the temperatur change. For this reason, temperature compensation is meaningful. Table 6.1 shows temperature compensation coefficients for NaCl solution.

Table 6.1 Compensation for NaCl solution, standard temperature 25°C, IEC746-3

T	Kt	α	T	Kt	α
0	0.54	1.8	60	1.76	2.2
10	0.72	1.9	70	1.99	2.2
20	0.90	2.0	80	2.22	2.2
25	1.00		90	2.45	2.2
30	1.10	2.0	100	2.68	2.2
40	1.31	2.0	110	2.90	2.2
50	1.53	2.1			

T6.1E.EPS

Kt: Conductivity as a ratio to value at 25°C.

T: Liquid temperature (°C).

CAUTION

If the output and display of the conductivity value without compensation is desired, set the coeffecient “0.00”.

6.2.1 Determining Temperature Coefficient

If the temperature coefficient of the solution to be measured is not known;

(1) Start by setting the coefficient to zero
(2) Measure the variation in conductivity over a range of 10 to 30 ℃ (for a standard temperature of 25℃)
(3) Derive a linear approximation for the temperature coefficient using the following equation:

Temperature coefficient **α**:

$$\alpha = \frac{K_2 - K_1}{K_1 (t_2 - 25) - K_2 (t_1 - 25)} \times 100 \ (\% / ℃)$$

where t1 , t2 : liquid temperature (℃)
K1 : conductivity at temperature t1
K2 : conductivity at temperature t2
25 : Standard temperature (℃)

F6.2.1-1E.eps

Calculation example:

Derive a linear approximation for the temperature coefficient for a solution that had a conductivity of 124.5 **μ** S/cm at 18.0 ℃, and a conductivity of 147.6 **μ** S/cm at 31.0 ℃ (Standard temperature is 25 ℃). Substituting t1 = 18.0, t2 = 31.0, K1 = 124.5, and K2 = 147.6:

$$\alpha = \frac{147.6 - 124.5}{124.5 \times (31.0 - 25) - 147.6 \times (18.0 - 25)} \times 100$$

$$= \frac{23.1}{747.0 - (-1033.2)} \times 100$$

F6.2.1-2E.eps

α = 1.298

For the EXA SC100 conductivity converter, the temperature coefficient can be entered with just three-digit precision, so we set 1.30

6.2.2 Setting Temperature Coefficient

(1) Setting Solution Temperature Coefficient

After determining the solution temperature coefficient (whether determined using the procedure in 6.2.1, or already known), follow the procedure below to set it.

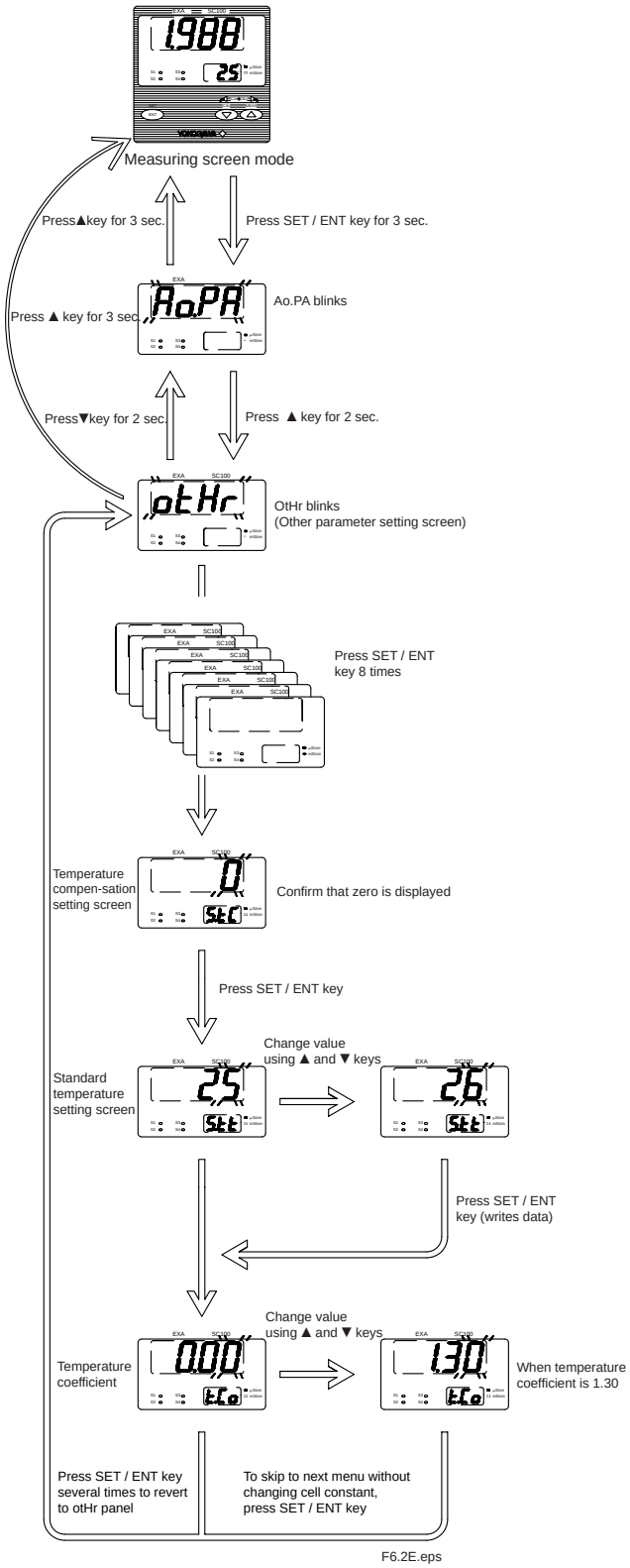


Fig. 6.2

(2) Setting temperature coefficient for NaCl solution

Procedure for setting NaCl temperature compensation is as follows:

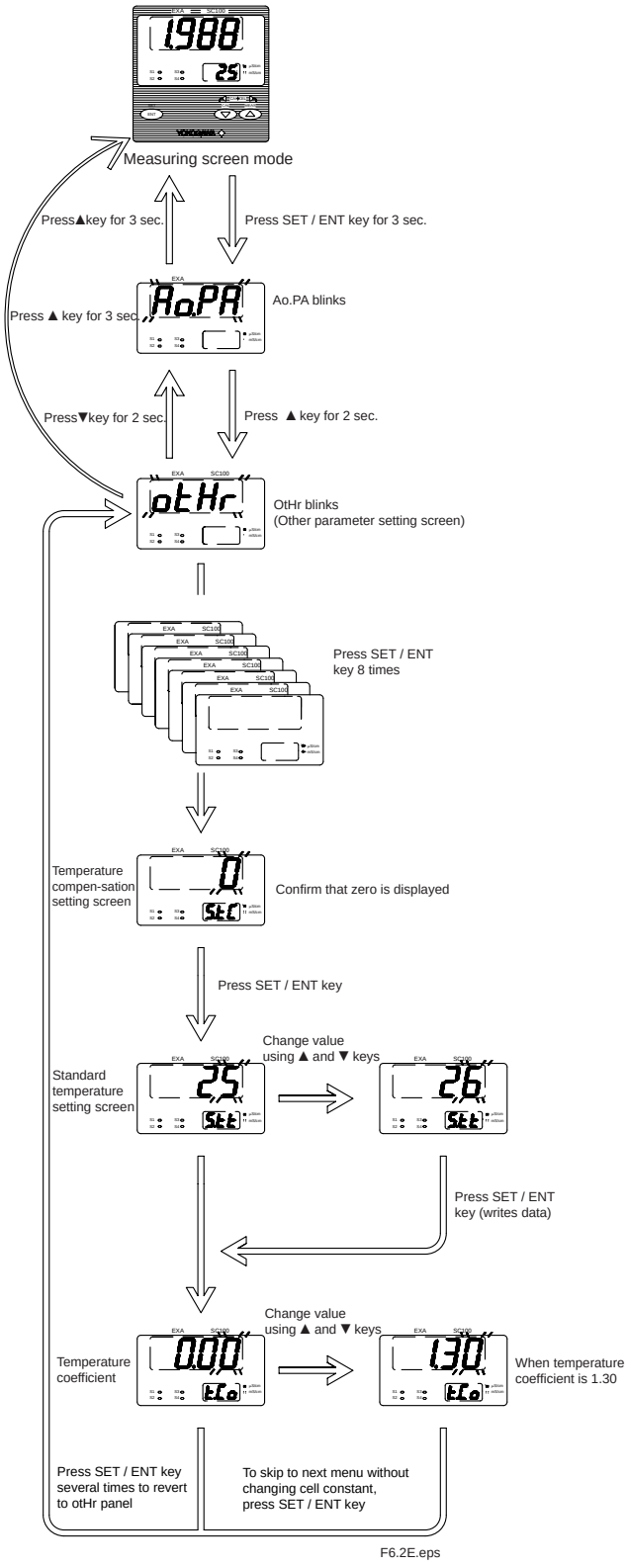


Fig. 6.3

6.3 Compensation for Wiring Resistance

The EXA SC100 is wired to a conductivity sensor, and the wiring resistance depends on the cable length between the converter and the sensor. Yokogawa's SC10XB conductivity sensor is offered with its cable length; selectable as 3 m, 5 m or 10 m. When the SC10XB is used with the WF100 terminal box, cable length between converter and sensor can be extended to 50 m (max.).

To measure conductivity accurately, the wiring resistance of the cable must be taken into account (the value needs to be set in the converter). The wiring resistance also needs to be taken into account for accurate temperature calibration. Wiring resistance setting and temperature calibration need to be performed once when a new detector is used.

6.3.1 Setting Wiring Resistance

The wiring resistance settings for different lengths of cables provided with Yokogawa's SC10XB and SC4A conductivity sensors are shown in Table 6.2 below.

Table 6.2

Cable length	SC10XB	SC4A
3m	0.60Ω	0.00Ω
5m	1.00Ω	0.05Ω
10m	2.00Ω (*1)	0.20Ω
20m	4.00Ω (*1)	0.50Ω
50m	10.00Ω (*1)	———

T6.3E.EPS

(*1) When cable is used with WF100, 0.2Ω (Total cable length m)

The resistance setting corresponds to the item Cb.r of otHr (Other Parameter Settings) in Sec. 5.1.3 (3). To minimize measurement error, you should measure the return resistance, subtract 0.1Ω from it, and set this value.

6.3.2 Temperature Calibration

For temperature calibration, use a solution at about the usually-measured solutions temperature. When the environmental temperature is very different from solution temperature, use sufficient amounts (4 liter or more) of solution so that the solution temperature won't vary during measurement. A thermometer should be prepared for getting accurate solution temperature data. The procedure for temperature calibration is described in "Sec. 5.1.3 (3) Other Parameter Setting screen tCL (temperature calibration)". Immerse the conductivity sensor (up to the level of the electrode to be wetted during operation) and the thermometer in the solution to be used for temperature calibration.

For more accurate temperature calibration, leave the sensor in solution in about two minutes to satbilize the measurement value at the solution temperature, before reading and setting the value.

Temperature calibration can be performed in the range -15 °C to +115 °C, and setting within the range -20 °C to +5 °C is possible for the compensation: the difference between the temperature measured by the conductivity sensor and the thermometer reading.

6.4 Zero Calibration (Calibration in Air)

The EXA SC100 is wired to a conductivity sensor, and the capacitance of the cable is proportional to the cable length between converter and sensor. For accurate conductivity measurement, cable capacitance needs to be compensated for. This cable capacitance has a particularly large effect on accuracy when measuring low conductivity values, and the purpose of the zero calibration (calibration in air) described below is to eliminate this error.

6.4.1 Procedure for Zero Calibration (Calibration in Air)

1) Press the ▼ key on the measurement panel for 3 sec. to switch to the manual calibration screen (the Aux. display should show “CAL”.)
2) Remove the sensor from the solution, completely wipe off any water, and leave the sensor in air.
3) Press the SET / ENT key. The Aux. display shows “CAL”, blinking (meaning Calibration Start).
4) Press ▲ key. The Aux. display shows “Air”.
5) Press the SET / ENT key. The Aux display shows “Str” (waiting for zero calibration).
6) Press the SET / ENT key. The measurement value blinks indicating that zero calibration (in air) has started.
   The Aux. display shows “WAI”.
7) This continues until zero calibration in air completes.
   Note: Zero calibration in air takes about 60 sec.
8) When zero calibration in air ends successfully, the Aux. display shows “Goo” blinking.
9) To return to the measurement mode, press the ▲ key for at least 3 sec.

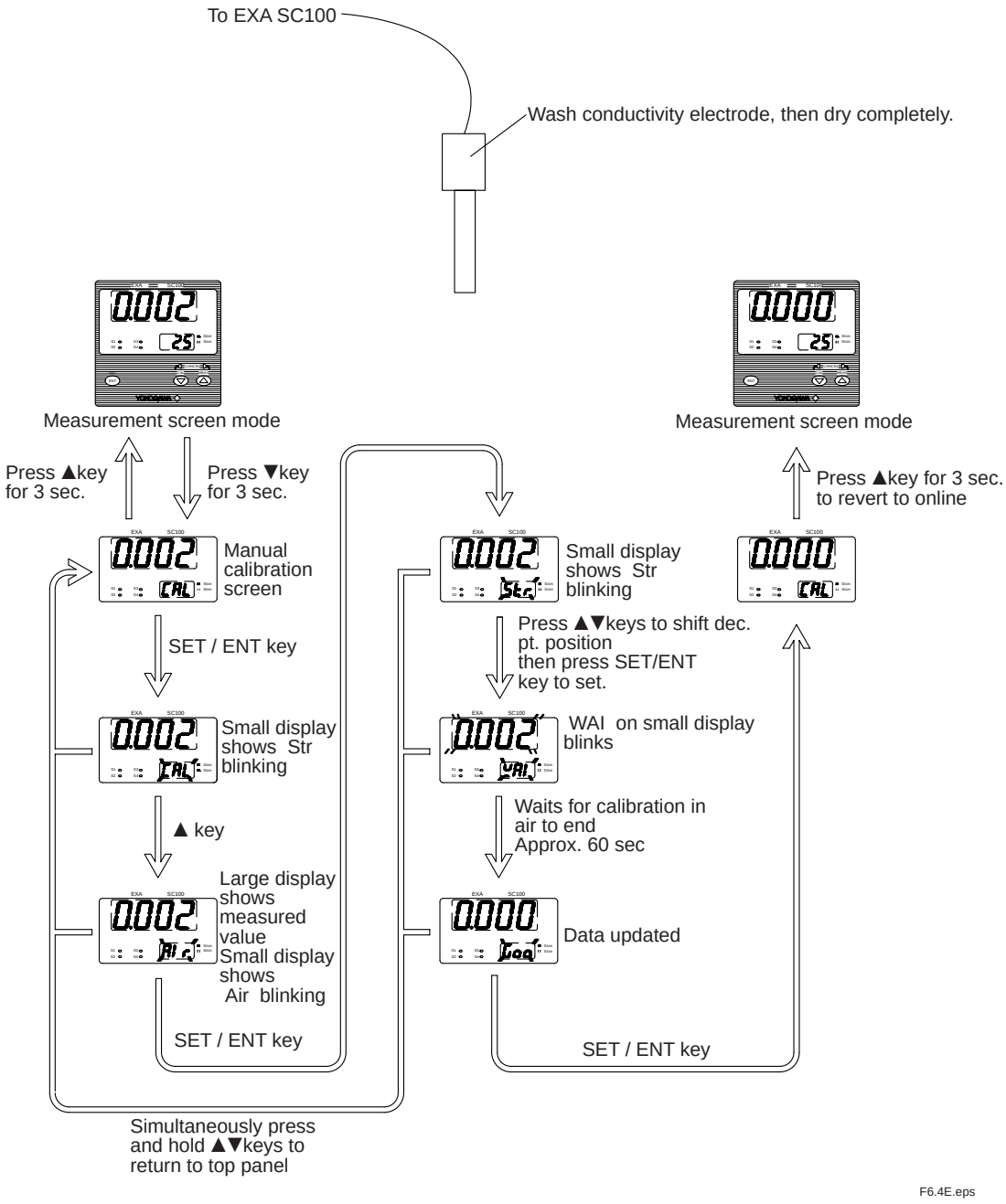

To EXA SC100
Wash conductivity electrode, then dry completely.
Measurement screen mode
Measurement screen mode
Press ▲key for 3 sec.
Press ▼key for 3 sec.
Press ▲key for 3 sec. to revert to online
Manual calibration screen
SET / ENT key
Small display shows Str blinking
▲ key
Large display shows measured value
Small display shows Air blinking
SET / ENT key
Small display shows Str blinking
Press ▲▼keys to shift dec. pt. position then press SET/ENT key to set.
WAI on small display blinks
Waits for calibration in air to end Approx. 60 sec
Data updated
SET / ENT key
Simultaneously press and hold ▲▼keys to return to top panel
F6.4E.eps

Fig. 6.4

6.5 Calibration with Standard Solution

When the EXA SC100 Conductivity Converter is used with a conductivity sensor, it is normally sufficient to enter the cell constant marked on the sensor cable once. However if the sensor becomes aging or deformed due to many-year use, the cell constant may change, resulting in errors. In this case, wash manually the electrode, calibrate it with standard solution, and re-set the cell constant in the converter.

CAUTION

Calibration with standard solution means measuring the conductivity of standard solution with the already-known conductivity value, and adjusting the converter so that it will display the conductivity of the standard solution.

There are usually two methods for calibration.
A method is to set the already-known conductivity value to the converter. The value is available from public documents; Table 6.2 is an example of already-known conductivity values. See section 6.5.1 for detailed explanation and procedure.
Another method is to set the conductivity measured by a standard conductivity meter to the converter. See section 6.5.2 for detailed explanation and procedure.

Table 6.2 Conductivity of NaCl solution at 25°C

wt %	mg/kg	Conductivity
0.001	10	21.4 µS/cm
0.003	30	64.0 µS/cm
0.005	50	106.0 µS/cm
0.01	100	210.0 µS/cm
0.03	300	617.0 µS/cm
0.05	500	1.03 mS/cm
0.1	1000	1.99 mS/cm
0.3	3000	5.69 mS/cm
0.5	5000	9.48 mS/cm
1	10000	17.6 mS/cm
3	30000	48.6 mS/cm
5	50000	81.0 mS/cm
10	100000	140.0 mS/cm

T6.2E.EPS

6.5.1 Calibration with Standard Solution (when using NaCl for standard solution)

(1) Before calibration, make sure the electrode is not dirty. If dirty, carefully wash it in pure water.
(2) Prepare standard solution on the basis of Table 6.3
Dissolve a prescribed amount of NaCl (purity 99.99% or greater) in water to produce a solution of accurately-known concentration. When preparing the standard solution, be sure to use pure water with conductivity less than 1/100 conductivity of the solution to be prepared, or equvalent to 1/100. After preparation, stabilize the standard solution at the standard temperature (initial setting is 25°C). The solution conductivity may be derived from public standard tables and from Table 6.3.
(3) Set the temperature compensation as NaCl and standard temperature as 25°C into the SC100 converter. Refer to Sec. 5.1.3 (3) Other Parameters setting mode.

Procedure for Calibration with Standard Solution

(1) On the measuring mode, press the key for 3 sec. to switch to calibration mode.
The Aux. display shows “CAL”
(2) After washing the electrode in pure water and wiping it off, immerse the sensor in standard solution.
(3) Press SET/ENT key. The Aux. display shows “CAL”, blinking (meaning start calibration).
(4) Press SET/ENT key. The measured value is displayed, blinking. The Aux. display shows “CAL”.
(5) Wait for measured value to stabilize, then press SET/ENT key.
The measured value display shows measured value with decimal point blinking.
The Aux. display shows “CAL”.
(6) Set decimal point position with ▲ and ▼ keys.
By pressing ▲ or ▼ key, you can move the decimal point.
(7) If you press the SET/ENT key, the lowest digit of the measurement value blinks.
(8) Set conductivity value with ▲ or ▼ key.
(9) Press SET/ENT key and measurement panel blinking stops. “Ent” is blinking on the smaller screen.
Note) At this time, the calibrated value has an effect on measurement value, but isn’t memorized. If you desire to repeat this calibration stage with the standard solution, press ▲ and ▼ key simultaneously.
(10) Press SET/ENT key (settlement of calibration data).
“Goo” blinks on the Aux. display.
The calibration results are written to EEPROM
(11) Press SET/ENT key. -> the converter moves to “CAL” stage in item (1) by this operation.
(12) Set the original temperature compensation and standard temperature before calibration with standard liquid. Unless they are set, the converter remains compensating the measurement value for NaCl solution. Refer to Temperature Compensation and Reference Temperature setting items in Sec. 5.1.3 (3) Other Parameters.
(13) After set the sensor to the original place, press ▲ key for 3 sec. and measurement screen is displayed.

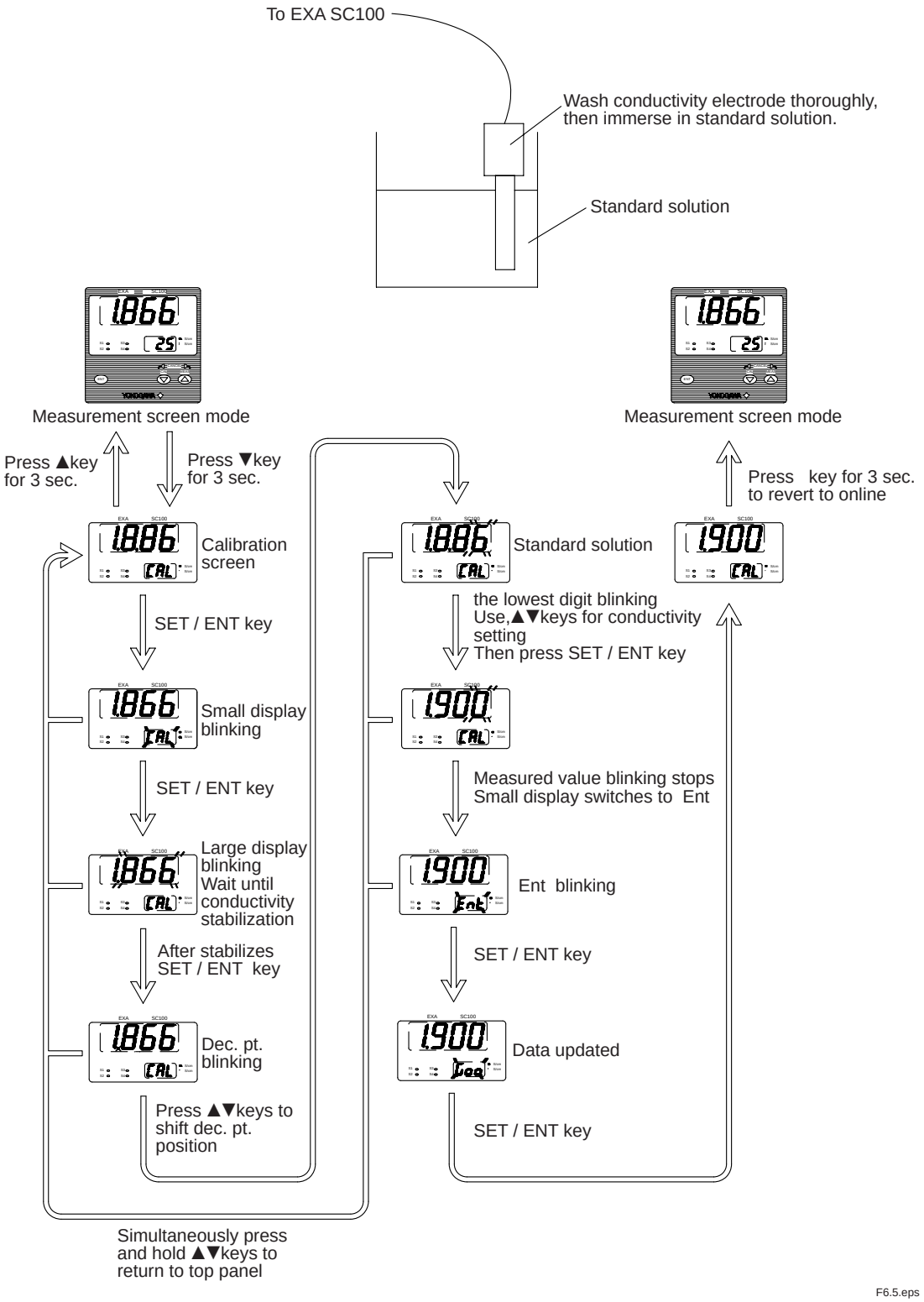

To EXA SC100
Wash conductivity electrode thoroughly, then immerse in standard solution.
Standard solution
Measurement screen mode
Measurement screen mode
Press ▲key for 3 sec.
Press ▼key for 3 sec.
Press key for 3 sec. to revert to online
Calibration screen
SET / ENT key
Small display blinking
SET / ENT key
Large display blinking Wait until conductivity stabilization
After stabilizes SET / ENT key
Dec. pt. blinking
Press ▲▼keys to shift dec. pt. position
Standard solution
the lowest digit blinking Use,▲▼keys for conductivity setting Then press SET / ENT key
Measured value blinking stops Small display switches to Ent
Ent blinking
SET / ENT key
Data updated
SET / ENT key
Simultaneously press and hold ▲▼keys to return to top panel
F6.5.eps

Fig. 6.5 Calibration with standard solution (when NaCl standard solution used)

6.5.2 Calibration (by comparison with reference conductivity meter)

Calibration procedure

(1) Before calibration, make sure the sensor isn't dirty. If dirty, wash it in pure water etc.

(2) Use, as calibration solution, the solution that has similar conductivity to usually-measured value at usually-measured temperature.

(3) Make sure that temperature coefficient and reference temperature settings of a reference conductivity meter are the same as those of the SC100 conductivity converter.

(4) Right after measuring conductivity with the reference conductivity meter, measure conductivity with the SC100.

CAUTION

In case of using the SC82 conductivity meter as reference, the immersion of both the SC82 sensor and the SC100 sensor is acceptable to calibrate. However, in using the other conductivity meter, check interaction of two sensors because the interaction may influence measurement.

(5) Calibrate the SC100 converter in accordance with item (1), (3)-(11) and (13) in the

6.5.3 "Procedure for Calibration with Standard Solution".

CAUTION

Use a reference conductivity meter to meet the following conditions:

- The arithmetic method for temperature compensation of the meter is the same as that of the SC100 converter.
- Temperature coefficient and reference temperature settings of the meter are the same as those of the SC100 conductivity converter. The different temperature compensation use may cause the calibration error.

It is recommended to use the SC82 personal conductivity meter as a standard.

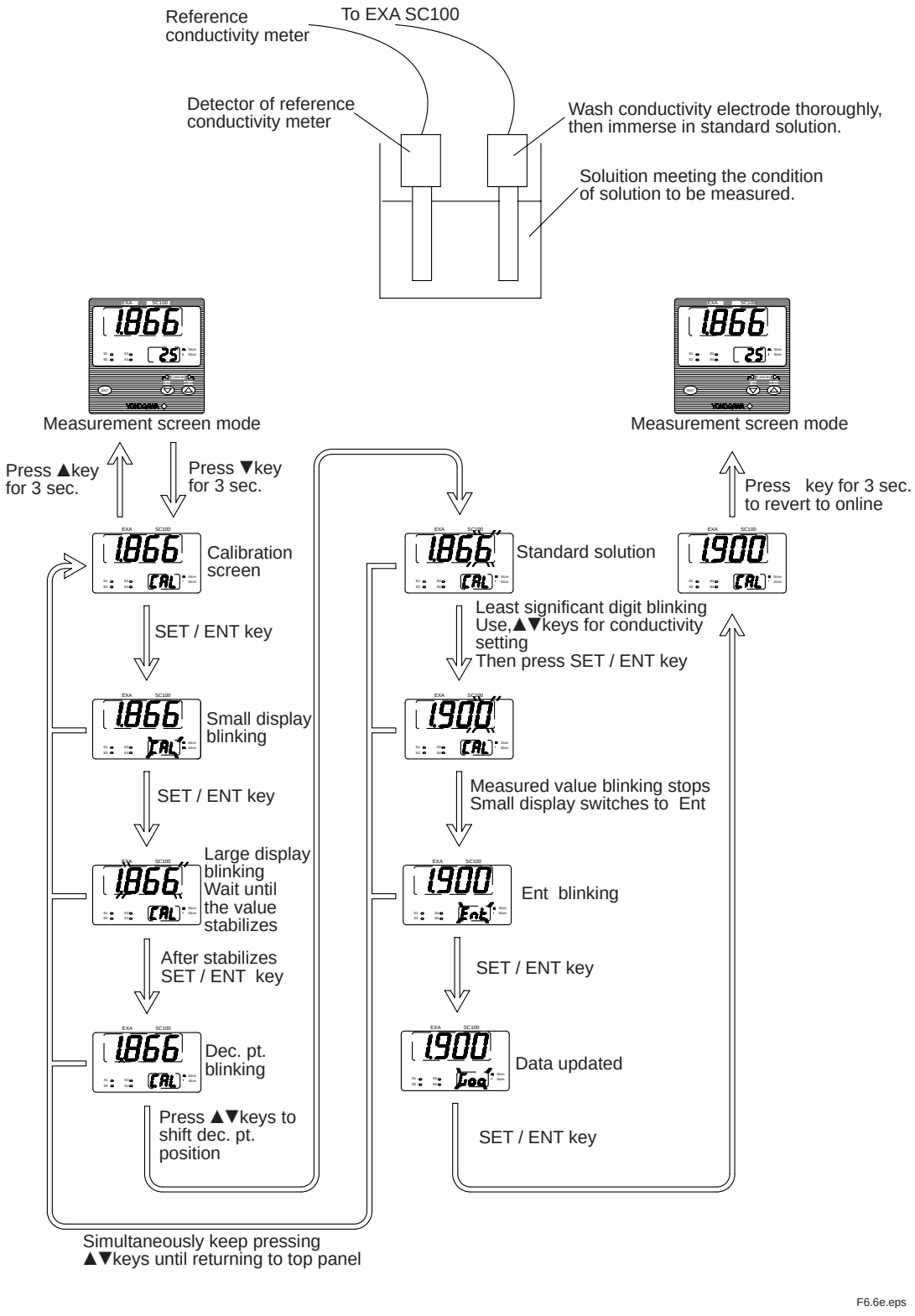

Reference conductivity meter
To EXA SC100
Detector of reference conductivity meter
Wash conductivity electrode thoroughly, then immerse in standard solution.
Soluition meeting the condition of solution to be measured.
Measurement screen mode
Measurement screen mode
Press ▲key for 3 sec.
Press ▼key for 3 sec.
Press key for 3 sec. to revert to online
Calibration screen
SET / ENT key
Small display blinking
SET / ENT key
Large display blinking
Wait until the value stabilizes
After stabilizes SET / ENT key
Dec. pt. blinking
Press ▲▼keys to shift dec. pt. position
Standard solution
Least significant digit blinking
Use,▲▼keys for conductivity setting
Then press SET / ENT key
Measured value blinking stops
Small display switches to Ent
Ent blinking
SET / ENT key
Data updated
SET / ENT key
Simultaneously keep pressing ▲▼keys until returning to top panel
F6.6e.eps

Fig 6.6 Calibration (by Comparison with Reference Conductivity Meter)

6.6 Canceling Calibration

To cancel calibration:

1) Simulateneously press ▲ and ▼ keys several times, and abort the present calibration (by this action even if calibration is completed successfully, converter parameters will not updated) and revert to the initial calibration screen ("CAL" is displayed on Aux. screen).
2) By pressing the key for at least 3 sec. until the measurement screen is displayed, revert to measurement screen mode.

6.7 Escaping from Error Occurrences During Calibration

If an error occurs, the calibration result is not updated into converter parameters.

(Refer to Tables 8.1 and 8.2 for detailed error codes)

6.7.1 Conditions which cause errors during calibration:

(1)Related to calibration with standard solution:
The case that the calculated cell constant has changed by more than 620% from the original cell constant.

Note: The calculated cell constant means the constant compensated by calibration, and the value which is displayed on the cell constant setting screen also has changed.

(2)Related to zero calibration:
The case that the zero point value is outside normal zero limits after calibration.

6.7.2 How errors are displayed when errors occurs during calibration:

Measurement value display: Measurement value continues to be displayed.

Auxiliary display: Error code is displayed and blinks

Simultaneous pressing ▲ and ▼ keys is the only acceptable key entry during the manual calibration screen: that is, only cancelling the calibration is possible (See 6.7.3 about things afer cancellation).

6.7.3 Procedure for Recovering from Errors

To repeat calibration :

1) Press ▲ and ▼ keys simultaneously to revert to initial calibration screen.
2) Press SET/ENT key to repeat calibration procedure.

To Quit the Calibration Panel

1) Press ▲ and ▼ keys simultaneously to revert to initial calibration screen.
2) Press the key for at least 3 sec. until the measurement screen is displayed.

CAUTION

Make sure that the sensor is in the process solution before pressing the keys to revert to the measurement screen and measurement screen mode.

7. Cleaning and Maintenance

7.1 Periodic Maintenance

7.1.1 Sensor Cleaning

CAUTION

The cleaning procedures described here are typical; the actual cleaning procedure will depend on the sensor materials and the application. The effects of cleaning cannot be guaranteed. Consider cleaning to be preventative maintenance. For appropriate procedures for cleaning the sensor, refer to the sensor manual.

When the electrodes of the conductivity sensor become dirty, this can affect the cell constant and the measurement accuracy. Usually, you should periodically clean the electrode.

1. In general applications, it is effective to wash the electrode in warm water with household soap.
2. For carbonate or hydroxide deposits, it's recommended to wash the electrode in 5% to 10% hydrochloric acid solution.
3. Organic (oily) deposits are best removed by acetone.
4. For algae, bacteria, or mould, use standard household bleach (Sodium hypochlorite solution).

WARNING

Never use an acidic type of cleaning agent, such as hydrochloric acid, with standard household bleach (sodium hypochlorite solution etc.). The dangerous toxic chlorine gas can be generated. When washing the sensor in warm water, in acid solution, or in sodium hypochlorite solution, be sure to ventilate well and to wear gloves to protect your body.

7.1.2 Calibration

When the conductivity sensor becomes dirty, the electrode surface will become covered by an insulating film, causing an increase in the cell constant and consequential measurement errors. You can calculate the errors from the equation below:

$$2 \times (Rv/Rcel) \times 100\%$$

Rv: Resistance of dirty layer

Rcel: Cell resistance

Refer to Sec. 6 for calibration with standard solution.

7.2 Checks and Preventive Maintenance

- **Checking Display of Conductivity Converter**

  Use soft tissue paper or cloth to wipe any dirt off the display of the EXA SC100 Conductivity Converter. You may also use wipers wetted with neutral detergent if required. Do not use organic solvents.

8. Troubleshooting

8.1 Determining whether trouble is in Sensor or Converter

Caution: If you ask Yokogawa service personnel to perform the following checks, you will be charged for this work fee.

A. If you think the displayed value is wrong

Step 1

• Make sure that converter settings are correct

(1) Make sure cell constant setting

(2) Make sure that wiring resistance has been set correctly

(3) Make sure that RTD type has been set correctly

(4) Make sure that temperature compensation type, reference temperature, and temperature coefficient have been set correctly.

For details of setting procedures, refer to Sec. 6

Step 2

• Make sure if sensor electrode cleanness
If dirty, then wash them as follows:
Washing procedure

(1) Use tap water to wash metal electrode tip of the sensor.

(2) If the dirt is hard to remove, remove the external part of the electrode (held by screws) and clean inner surface of external electrode and metal parts of sensor tip (including around the screws which hold it together) with a soft cotton wool swap or cloth. Be careful not to scratch the electrode surface.

(3) The neutral aqueous solution (cold or hot) can improve the cleaning effectiveness.

(4) After washing, fix the external electrode again and wash the whole of the sensor in tap water.

Step 3

• Make sure that the temperature value displayed on the conductivity meter accurately shows the temperature of the measured solution. If it does not show, check as follows:

(1) Make sure that the sensor's temperature terminals (T1, T2) are correctly connected to the converter.

(2) Disconnect the temperature terminals (T1, T2) from the converter, measure resistance between terminals at room temperature (about 25℃) and verify the resistance it by Table 9.3 If there is a big difference between them, the wires may be broken or the insulation may be poor. In this case, replace the conductivity sensor.

(3) If no problem is found in steps (1) and (2), perform temperature calibration. The procedure for temperature calibration is described in Sec. 6 above.

Step 4.

• Perform zero calibration (calibration in air), and calibration in standard solution. The procedure for zero calibration is described in Sec. 6.

(1) If an error occurs during calibration, refer to item B “Escaping from Error Occurrences during Calibration” (page 8-4).

(2) If an error does not occur during calibration, but calibration is not completed normally, check the followings:

① If zero calibration (calibration in air) is not successful, make sure that any liquid doesn’t remain on the electrodes. If it remains, dry the electrode then repeat zero calibration.

② If calibration with standard liquid is not successful, check no moisture and no drop water on the electrode and the correct setting of the temperature compensation method. Also re-make sure standard solution concentration is correct. If not correct, prepare a fresh standard solution and try calibration again.

Step 5.

• Make sure that the electrode tip of the conductivity sensor is not damaged.

(1) Remove the outer electrode (held by screws) and make sure that the inner surface of the outer electrode and the surface of the inner metal electrode are not dent and scratched.

(2) If the metal parts of the electrodes are damaged, replace the sensor.

Step 6.

• Check good insulations not only between terminals of conductivity sensor cable but also between terminals of converter.

(1) Remove terminals of the conductivity sensor from the converter. Before measuring, Check no moisture and no drop water on the electrode Make sure that insulation between terminals is at least 1M**Ω**. If the resistance between electrodes is low, the cable insulation is probably poor, so you should replace the sensor.

(2) Check no dirt and no moisture (that might lower the insulation) between the sensor terminals of the conductivity converter. If there is dirt or moisture, wipe them with a dry cloth or a cloth containing pure alcohol. Use a drier if it is difficult to remove moisture.

Step 7

• Make sure that conductivity converter is not abnormal

(1) Remove the conductivity sensor terminals C1, C2 from the conductivity converter, and connect a 1 k**Ω**±1% resistor instead.

(2) Make sure that it the measurement value of the converter agrees with the conductivity calculated from the below expression. If their difference is than ±10%, replace the converter because it is probably out of order.

Conductivity [S/cm] = cell constant set in converter [cm^{-1}] / resistance in ohms of connected resistor.

Calculation example:

When cell constant set in converter is 0.05 [cm-1], and resistance of connected resistor is 1**Ω**, we have:

Conductivity = 0.05 / 1000 = 0.00005 [S/cm] = 50 [**μ** S/cm]

Since this conductivity is calculated without temperature compensation, set the temperature compensation coefficient to 0.00 when checking the conductivity with the resistor.

(3) Remove the resistor connected between the terminals C1, C2 of the conductivity converter, and reconnect the conductivity sensor cable to the terminals. Next remove the cable terminals T1, T2 of the conductivity sensor from the conductivity converter, and connect a 1Ω±1% resistor instead.
(4) Make sure that the conductivity sensor temperature is displayed in the range of -10°C to 10°C. If not displayed, the converter is probably defective and should be repaired or replaced.
(5) If the converter is defective, restore its converter settings and the wiring to the sensor, and proceed to Step 8.
If the converter is defective, then contact the agent you purchased it from, or the regional service station.

CAUTION

If you request Yokogawa or its agent to remove or replace the converter and they work for doing, their work fee shall be charged.

Step 8.

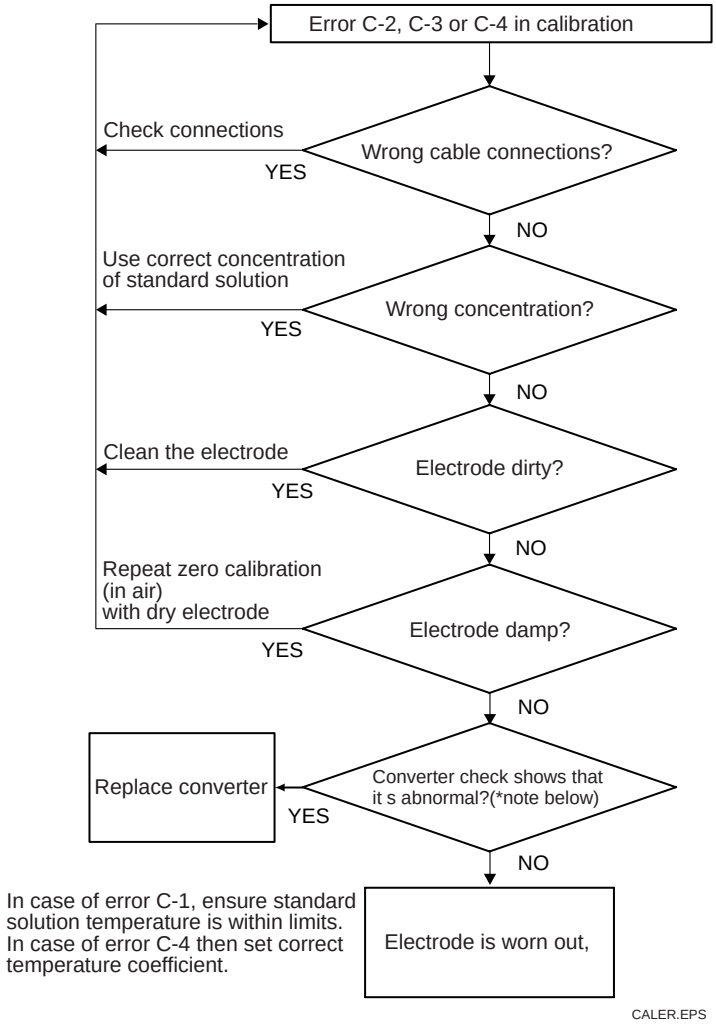
A. Re-check the errors or troubles, and take countermeasures following the below procedures.

(1) Take countermeasures, referring to Table 8.4 in Sec. 8.4 “Diagnosing Cause of Abnormal Measurement Results”.
(2) If you diagnose the causes and take the countermeasures but still cannot solve the problems, the conductivity sensor is probably due to its product life and should be replaced with a new one.

B. If an Error Occurs in Calibration (Related errors are C-1 to C-4).

Refer to the diagnostic flow chart below.

For details of any error, refer to Sec. 8.3

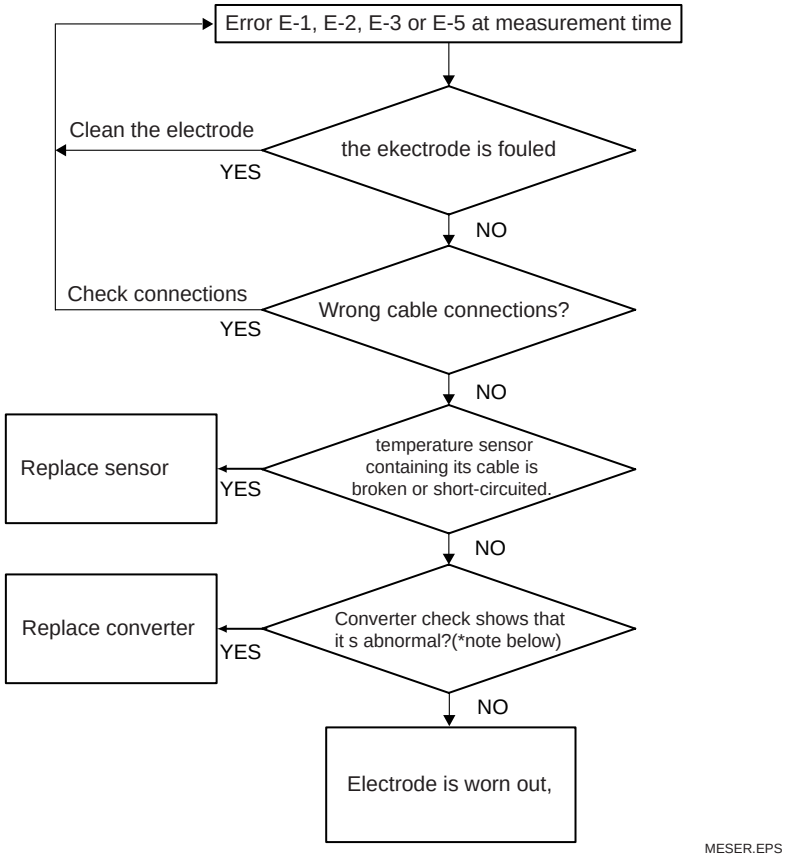


Note: Refer to the procedure for checking the converter described in Step 7.

C. If an Error Occurs at Measurement time (Related errors are E-1 to E-5).

Refer to the diagnostic flow chart below.

For details of any error, refer to Sec. 8.3



Note: Refer to the procedure for checking the converter described in Step 7.

If the error E-4 occurs:

The converter is probably abnormal due to fault. If the error recurs after turning power OFF then ON again, remove the converter and contact the agent you purchased it from or the regional service station, for replacement or repair.

CAUTION

If you request Yokogawa or its agent to remove or replace the converter and they work for doing, their work fee shall be charged.

D. If the problem is not solved by replacing the conductivity sensor

The converter is likely to be abnormal. Perform Step 1 through Step 8 of Sec. A “If you think the displayed value is wrong” above. If the converter is abnormal after performing these steps, contact the agent you purchased it from or the regional service station, for replacement or repair.

CAUTION

If you request Yokogawa or its agent to remove or replace the converter and they work for doing, their work fee shall be charged.

8.2 Error display

If an abnormality is detected in the EXA SC100 Conductivity Converter, a blinking error code is displayed in the message area and the FAIL contact also operates in case of selecting the FAIL functions for contact outputs. The analogue outputs also become burnt down (2 mA) if the analog output is set to “hold output”. Related error codes and their meanings are listed in the table 8.1 and 8.2:

Table 8.1

Error code	Aux. display	Meaning of error
1	E-1	Conductivity input is outside measurement range
2	E-2	Temperature measurement out of range
3	E-3	Temperature sensor abnormal
4	E-4	Converter abnormal
5	E-5	Temperature correction out of range

T8.1E.EPS

Table 8.2

Calibration Error	Aux. display	Meaning of error
1	C-1	Standard solution temperature out of range
2	C-2	Calibration error
3	C-3	Zero calibration abnormal
4	C-4	Standard liquid conductivity outside measurement range

T8.2E.EPS

Details of these error codes are described in Section 8.3.

8.3 Things to do when an error is detected

When an error occurs, check the displayed error code and take actions as follows:

Note:

Error code keeps on display until the cause of the error is solved.

8.3.1 Error E-1 Conductivity input is out of measurement range

Aux. display: E-1

[Cause]

Conductivity input signal from the sensor is too small or large to measure accurately.

[Things to do]

1. Check connection between the sensor and the converter.
2. Make sure that the sensor or cable is not abnormal.
3. If the sensor is found to be broken, replace it.

8.3.2 Error E-2 Temperature measurement is out of range

Aux. display shows E-2

[Cause]

Temperature input resistance is out of measurement range.

[Things to do]

1. Check the connection between the sensor and the converter.
2. Temperature of measured solution should be within the range -10 to 110°C.
3. If temperature of solution is within the permissible range but error still occurs, the sensor is probably broken and should be replaced.

8.3.3 Error E-3 Temperature sensor abnormal

Aux. display: E-3

[Cause]

Sensor wiring broken or wires shorted. Type of RTD used to measure temperature does not agree with RTD setting in converter (error E-2 in this case).

[Things to do]

(1) Check if the RTD type of the used sensor agrees with the RTD type set in the converter.

(2) Make sure the electrical connections (temperature terminal: T1 and T2) between the sensor and the converter. If their connections are incorrect, re-connect the properly. Even though an error still occurs, temperature sensor is probably bad - replace the conductivity sensor.

(3) Remove sensor from measurement solution and leave it to reach room temperature. Disconnect the sensor cable terminals (T1, T2) from the converter, and measure the resistance between the terminals. The resistance of each RTD type at 25°C is shown in Table 8.3; verify that the measured resistance is correct.

Table 8.3 Temperature of different types of RTD at 25°C

RTD temperature	Resistance
Pt1000	Approx.1100 Ω
Pt100	Approx.110 Ω

T8.3E.EPS

8.3.4 Error E-4 Converter abnormal

Aux. display: E-4

[Cause]
Converter is abnormal.

[Things to do]
Turn power OFF then ON again. If the error recurs, then contact Yokogawa.

8.3.5 Error E-5 Temperature Compensation Out of Range

Aux. display: E-5

[Cause]
Temperature compensation is out of range. The screen shows [- - - -]

[Things to do]
Refer to Sec. 6.2.1, determine the temperature coefficient, and re-set this value.

8.3.6 Calibration Error C-1 Standard solution temperature out of range

Aux. display: C-1

[Cause]
At calibration time, standard solution temperature was measured out of the temperature range 0°C to 100°C.

[Things to do]
Use solution within the permissible temperature range.

8.3.7 Calibration Error C-2 Calibration abnormal

Aux. display: C-2

[Cause]
The compensated cell constant is out of the range of ±20% of the set cell constant.

Note:

The set cell constant is the value directly inputted into the converter (Refer to sec 6.1).

The compensated cell constant is the value which is calculated and compensated with the calibration by standard solution,

[Things to do]

1. Make sure sensor isn't dirty. If dirty, wash the electrode.
2. Make sure bubbles wasn't stuck to the electrode at time of calibration with standard solution. If stuck, dislodge them by wishing the sensor up and down and re-calibrate the sensor.
3. Make sure the concentration of the used calibration solution is correct.
4. If the above do not solve the problem, then the electrode is probably deteriorated due to aging. Replace the sensor.

8.3.8 Calibration Error C-3 Zero calibration abnormal

Aux. display: C-3

[Cause]
At zero calibration time, zero point was out of the permitted range.

[Things to do]
1. Make sure sensor is dry. If not dry, wipe off water and dry it.
2. If the above does not solve the problem, then the electrode is probably deteriorated due to its aging. Replace the sensor.

8.3.9 Calibration Error C-4 The used standard liquid conductivity out of measurement range

Aux. display: C-4

[Cause]
The used standard liquid conductivity was out of measurement range.

[Things to do]
1. Check the electrical connection between the sensor and the converter.
2. Check the sensor cable.
3. If the sensor is found defective, replace it.

8.4 Things to do when measurement value is abnormal.

When abnormal measurement value occurs and obstruct operation, refer to Table 8.4.

Table 8.4 Causes and solution for troubles

Trouble	Cause	Solution
Unstable measurement value in spite of stable actual solution conductivity	1. Air bubbles exist in solution 2. Poor insulation in electric circuit 3. Power supply fluctuate beyond permissible range 4. Influenced by the temperature fluctuation of solution.	1. Improve measuring place 2. Remove dirt and moisture on the converter terminals 3. Make power stable 4. Control solution temperature and/or set temperature compensation
Lower measurement value than the actual	1. Poor insulation of the cable or its connection 2. Poor connection of temperature element wiring 3. Poor immersion of the electrode into solution	1. Restore the insulation to the $1\times10^{8}\Omega$ or more. 2. Check the resistance between T1 and T2 terminal of the sensor at about 25°C.If it is very different from measurement value, replace the sensor. 3. Re-position the sensor so that its electrode will be sufficiently immersed
Higher measurement value than the actual	1. Poor connection of temperature element wiring	1. Check the resistance between T1 and T2 terminal of the sensor at about 25°C.If it is very different from measurement value, replace the sensor.
Slow response	1. Solution is not exchanged in the measuring place. 2. Poor immersion of the electrode into solution 3. Flow rate is low	1. Improve the measuring place so that solution can be exchanged. 2. Re-position the sensor so that its electrode will be sufficiently immersed 3. Change to higher flow rate.
Hunting measurement value	1. Air bubbles exist in solution	1. Improve measuring place

T8.4E.eps

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